L. J. Friedman 2/18/14.2

3.X.104
[illegible]

Human Placentation

An Account of the Changes in the Uterine Mucosa and in the Attached Fetal Structures, During Pregnancy

By J. CLARENCE WEBSTER

B.A., M.D. (Edin.), F.R.C.P.E., F.R.S.E.

PROFESSOR OF OBSTETRICS AND GYNECOLOGY, IN RUSH MEDICAL COLLEGE (AFFILIATED WITH THE UNIVERSITY OF CHICAGO); FELLOW OF THE AMERICAN AND CHICAGO GYNECOLOGICAL SOCIETIES, AND OF THE EDINBURGH OBSTETRICAL SOCIETY; CORRESPONDING MEMBER OF THE ROYAL ACADEMY OF MEDICINE, PALERMO, ITALY, AND OF THE ITALIAN OBSTETRICAL AND GYNECOLOGICAL SOCIETY; LATE LECTURER ON GYNECOLOGY, M'GILL UNIVERSITY, MONTREAL; FORMERLY FIRST ASSISTANT IN THE DEPARTMENT OF MIDWIFERY AND DISEASES OF WOMEN, UNIVERSITY OF EDINBURGH, SCOTLAND : : : : : : :

With 233 Illustrations

W. T. Keener & Co., 90 Wabash Avenue
Chicago : Nineteen Hundred and One

To

Charles Sedgwick Minot, Harvard

A. A. W. Hubrecht, Utrecht

Franklin P. Mall, Johns Hopkins

AMERICAN MEDICAL ASSOCIATION PRINT
CHICAGO: NINETEEN HUNDRED AND ONE

TABLE OF CONTENTS.

INDEX.

LIST OF ILLUSTRATIONS.

I.—FIGURES IN TEXT.

II.—FIGURES IN PLATES.

(From drawings and micro-photographs by the Author.)

PLATE X.

Figs. 57, 58, 59, 60, 61, Decidua vera in sixth week; 62, 63, 64, 65, Vera and membranes at full time.

PLATE XI.

Figs. 66, 67, 68, 69, 70, 71, Vera and membranes at full time; 72, Vera and membranes in a Porro uterus: 73, Vera and membranes in fourth week.

PLATE XII.

Fig. 74, Decidua reflexa in fourth week: 75, 76, 77, Decidua reflexa in fourth month; 78, 79, Decidua reflexa in sixth week; 80, Decidua reflexa in fourth month.

PLATE XIII.

Fig. 81, Cervix in fifth month: 82, 83, 84, 85, Decidua serotina in fifth week: 86, 87, Decidua serotina in sixth week.

PLATE XIV.

Figs. 88, 89, 90, 91, 92, 93, 94, 95, Decidua serotina in sixth week.

PLATE XV.

Figs. 96, 97, 98, Decidua serotina in sixth week; 99, 100, 101, 102, 103, Decidua serotina in fourth month.

PLATE XVI.

Figs. 104, 105, 106, 107, Decidua serotina in fourth month; 108, 109, 110, 111, Decidua serotina in sixth month.

PLATE XVII

Figs. 112, 113, 114, 115, Decidua serotina in sixth month; 116, 117, 118, 119, Decidua serotina at full time.

PLATE XVIII.

Figs. 120, 121, 122, 123, 124, 125, 126, 127, Decidua serotina and villi at full time.

PLATE XIX.

Figs. 128, 129, 130, 131, 132, 134, 135, Decidua serotina and villi at full time.

PLATE XX.

Figs. 136, Decidua serotina and villi at full time: 137, 138, 139, 140, 141, 142, 143, Decidua and villi in fifth week.

PLATE XXI.

Figs. 144, 145, 146, 147, 148, Villi in fifth week: 149, 150, 151, Villi in sixth week.

PLATE XXII.

Figs. 152, 153, 154, 155, 156, 157, 158, Villi and serotina in sixth week.

PLATE XXIII.

Figs. 159, 160, Villi and serotina in sixth week: 161, 162, 163, 164, 165, 166, Villi and serotina in fourth month.

PLATE XXIV.

Figs. 167, Villi in fourth month: 168, 169, 170, Amnion and chorion in sixth month; 171, Chorion at full time: 172, 173, Chorion in sixth month.

PLATE XXV.

Figs. 174, 175, 176, 177, 178, Chorion and villi in sixth month; 179, 180, 181, Amnion and chorion at full time.

PLATE XXVI.

Figs. 182, 183, 184, 185, 186, 187, 188, 189, Chorion and villi at full time.

PLATE XXVII.

Figs. 190, 191, 192, 193, 194, Separation plane in four-week abortion; 195, 196, Separation plane in six-week abortion; 197, Separation plane in four-week abortion.

PLATE XXVIII.

Figs. 198, 199, 200, Separation plane in four-month abortion; 201, 202, 203, 204, Separation plane in six-month miscarriage.

PLATE XXIX.

Figs. 205, Separation plane in sixth month: 206, 207, 208, 209, 210, Separation plane at full time.

PLATE XXX.

Figs. 211, Non-placental area of inner surface of post-partum uterus: 212, 213, 214, 215, 216, Placental area of inner surface of post-partum uterus.

INTRODUCTION

There is no department of embryology in which greater differences of opinion exist than in that which is the subject of this research. Recent investigations, instead of harmonizing divergent views, have only tended to aggravate dissension.

This state of matters is due to several causes. In the first place, there is a prevailing tendency among certain workers to accept as unquestionable, and beyond challenge, statements made by older investigators of great renown. *Parva sub ingenti* is a motto worthy of constant attention, but its strict application in scientific research is not likely to be followed by the best results. Much as we are indebted to the pioneers in embryological work for their minute descriptions of macroscopic appearances, we are forced to regard many of their accounts of microscopic relationships as of secondary importance. Indeed, in several instances their value can only be estimated in terms of the fallacies which have been spread broadcast by their publication. We have passed beyond the era of the dissecting-knife and hand-lens, and have learned the value of more refined methods in the examination of embryonic tissues.

Another fertile source of trouble is the prevalent baneful habit of establishing sweeping generalizations from facts derived from the study of single specimens. It is as reasonable to write the whole history of America from a study of President Lincoln's administration as to explain the development of the placenta from the examination of, say, a three months' pregnant uterus. It is necessary to make a comparison of different stages. But, more than this, no satisfactory work can be done in human embryology unless a careful phylogenetic study be carried on at the same time. An embryologist who confines himself to the human embryo works

without the key to the solution of many difficulties, and is consequently forced to have recourse to specious speculation.

One must also mention the hurtful influence of party or national bias in the discussion of scientific problems. The causes of this unfortunate complication are not to be easily explained. It is apt to be manifested especially among younger investigators. Thus, the department of embryological research, with which I am particularly concerned, has become, even in its widest mammalian relationships, a fierce battleground; the contending parties being, on the one hand, a Teutonic host, and, on the other, a triple alliance of French, Belgians, and Dutch; a few British and Americans being found with both parties.

As a result of this state of matters, confusion is being worse confounded, and, in addition, owing to lack of uniformity as regards nomenclature, new investigators find it difficult to assign to the different published works their proper proportional values, or to correlate them in an intelligible synthesis.

Very recently attempts have been made to establish the pathology of the so-called "Deciduoma Malignum." I am safe in saying that no microscopic examinations of any tissue in the body have given rise to so many different interpretations and explanations. For example, in regard to one set of cells described, some observers think that they are maternal in origin; others that they are fetal. Some think they are in no way connected with the influence of pregnancy, but are due to degeneration in the new growth; others think they are entirely related to the influence of gestation. There are also differences of opinion as to whether they are of epiblastic or mesoblastic origin. These differences must be related primarily to the faults of embryologists; they are mainly accountable for the confusion of the pathologists. "Deciduoma malignum" will be a *casus belli* just as long as the embryologists differ in regard to the normal changes in the decidua and in the attached fetal structures.

In the course of my investigations, which have been carried on during the past eleven years, I have examined the pregnant uterus

during the second, third, fourth, fifth, sixth, seventh, eighth, and ninth months, in the first and second stages of labor, in the third stage (removed by Porro-Cæsarian section), and during various stages of the puerperium.

In addition, I have studied a number of complete abortions in the early weeks, as well as the placenta and membranes in the later months of pregnancy. I have also examined the pregnant uterus in various stages in the mouse, rat, rabbit, guinea-pig, pig, sheep, and cow.

I have also made a careful study of the normal mucosa of the corpus uteri in the non-pregnant state for the purpose of demonstrating clearly certain facts which must be emphasized in order rightly to appreciate the changes which occur in pregnancy. The main part of my work was carried out in the laboratory of the Royal College of Physicians, Edinburgh, and, in 1896, it gained for me the First Research Prize of the college. In the same year it was brought before the Royal Society of Edinburgh.

With the aid of the assistant in the Laboratory of the College of Physicians, I have taken a large number of microphotographs—about two hundred and twenty. The difficulty of preparing them was great, owing to the many serial sections which had to be examined and to the troublesome details of the technique. I consider, however, that I am repaid for my trouble in being able to publish such a large series of illustrations demonstrating the changes in the decidua and attached fetal structures throughout the greater part of the gestation period.

To those of my former colleagues in the University and in the School of Medicine, Edinburgh, to whom I am indebted for several specimens, and from whose criticism I have often benefited, I desire to express my deepest gratitude. In particular would I thank Sir John Batty Tuke, Curator of the Laboratory; Dr. Noel Paton, Superintendent; Drs. Berry Hart, Lovell Gulland, and other co-workers with whom it was my privilege to be associated for many years.

The Edinburgh portion of my investigation was published in

several numbers of the *American Gynæcological and Obstetrical Journal* during 1897. To the editor, Dr. J. D. Emmet, I am much indebted for his kindness in allowing me to reproduce the text which appeared in his journal.

I desire also to acknowledge Dr. Palmer Findley's valuable assistance in the revision of proofs.

J. CLARENCE WEBSTER.

Rush Medical College, Chicago. March, 1901.

CHAPTER I.

THE STRUCTURE OF THE MUCOUS MEMBRANE OF THE CORPUS UTERI IN THE ADULT NULLIPARA.

The mucosa of the body of the adult uterus has, when examined fresh between the menstrual periods, a fairly smooth surface, and is of a grayish pink color. With a low magnifying glass numerous small pits, the openings of glands, can be seen. These vary in number in different places. On microscopic examination, the thickness of the mucosa is found to vary considerably in different parts. In my specimens it varied from 1 to 4 mm. The average thickness is probably something between 2 and 3 mm. In detail the mucosa is best described under the following headings:

Lining Epithelium.
Glands.
Interglandular Tissue.

LINING EPITHELIUM.

This consists of columnar ciliated cells. Their nuclei are mostly elongated in the direction of the long axis of the cell; they are like short rods with rounded ends. Many are oval or ovoid; a few are rounded. For the most part they are placed in the deeper portions of the cells, only a small amount of cell substance being below them; sometimes the nucleus is quite close to the margin. In some cases it is situated in the middle or outer division of the cell. The height of the cell varies. This variation is due to the differences in the amount of cell substance, or of nuclear material. In many places small cells are found between the bases of the large fully formed cells.

In many carefully prepared thin sections a layer of flattened connective tissue cells, belonging to the interglandular tissue, can generally be recognized, adhering closely to the under surface of the layer of columnar epithelium. It is to be regarded as a basement membrane. In some sections it cannot be distinguished.

GLANDS.

The glands are not uniformly distributed, being more abundant in some parts than in others. They are tubular, and are single or branched.* The number of branchings is usually only two or three; possibly, sometimes, more may be found. The divisions occur mainly in the deepest portion of the mucosa; sometimes in the outermost portions, even close to the surface. Very often they occur about the middle of the mucosa.

Most of the glands run obliquely to the surface, some being found, occasionally, almost parallel with the surface. A few only run at right angles to it.

Some are straight, others slightly curved. Most are more or less tortuous or wavy. Of the latter, most are straight near the surface, but a few are wavy in their whole extent. On transverse section the glands are round or somewhat oval.

Most of the glands extend to the muscular part of the uterine wall; some reaching it, others stopping a little short of it. Here and there glands extend into the muscular layer for varying distances.

The gland-epithelium is of the same nature as that lining the surface of the mucosa, though, on the average, its cells appear to be a little larger. The size of the epithelium varies in different glands. When a surface view is obtained, the outlines of the cell-ends appear to be more or less rounded, though some are quite irregular.

INTERGLANDULAR TISSUE.

This forms the main portion of the mucosa. Its line of junction with the muscle of the uterine wall is an irregular one. Mus-

cular projections of different lengths extend into the deep portions of the mucosa.

It is composed of connective tissue of a low or embryonic type. It is best described as mainly consisting of delicate anastomosing nucleated masses of protoplasm. In some parts it is like a network with well-marked spaces, the anastomosing filaments being very fine. In other parts the matrix is almost a homogeneous mucoid-like mass containing rounded nuclei, very few spaces being seen, or scarcely any differentiation into distinct cells. In general, however, more or less distinction exists between the cells, though, for the most part, they remain connected by strands of matrix of various sizes. Close to the surface of the mucosa, the cells are usually flattened parallel to it. The larger the cells, the more elongated they are.

The nuclei are rounded or oval in general, the matrix surrounding them being irregular in shape and possessing one or more branching processes. Here and there groups of cells are found which are rounded, oval, or spindle-shaped. with no anastomoses. Often the nuclei may be seen dividing. (The embryonic appearance of the interglandular tissue becomes more or less altered in chronic endometritis.)

Close to the epithelium of the glands and to that of the surface is a layer of flattened cells forming a basement membrane. To it the epithelium appears to be attached.

Arteries and veins extend from the muscular part of the wall into the mucosa for varying distances. The former run a tortuous or wavy course usually; the latter a straighter course. At what level they pass into the capillaries which supply the outer layer of the mucosa it is difficult to say. As a rule this seems to take place just outside the middle part of the mucosa. In the outer part I find mainly capillary vessels, mere tubes of flattened endothelium. Here and there a small arteriole with scarcely any wall outside the endothelium may be found in the outer portion of the mucosa. Its wall consists of one or more layers of flattened cells of the interglandular tissue surrounding it. It is this appearance which has

often been wrongly described by observers, who have supposed the vessels to be arteries.

According to Minot, the capillaries form a network around the glands. If he means that a special vascular mesh is particularly noticeable around them, I can not agree with him. I have found them no more numerous near the glands than in any other part of the interglandular tissue, in which they are distributed in no uniform manner.

As to the lymphatics, I am in agreement with Leopold. The spaces in the interglandular stroma contain lymph, and they are drained by lymphatics proper, which begin in the deeper layers of the mucosa or in the muscle. In these spaces leucocytes are found, varying greatly in numbers in different parts.

In conclusion, I would point out that the mucosa might well be described in terms which are generally only used in reference to the altered condition of pregnancy—viz., compact and spongy; the former being the outermost portion, in which the glands have not, for the most part, begun to divide, and the latter being the deeper portion, in which are the branchings of the glands. Strictly, the spongy layer might be considered as consisting of two parts, an outer and a deeper, the latter being that next the muscle containing the most numerous gland spaces.

The following points regarding the mucosa of the body of the uterus should be kept in view:

1. Its thickness is not uniform, but varies considerably.

2. The superficial epithelial cells show variations in height, thickness, shape, size, and in the position of their nuclei.

3. The same may be said of the epithelial cells lining the glands. In general these are larger than the surface cells.

4. The interglandular connective tissue is mainly embryonic in nature, consisting of a nucleated protoplasmic reticulum. Here and there are found all stages of transformation to the more advanced spindle-shaped cells.

5. The connective tissue cells nearest the surface of the mucosa are arranged, for the most part, parallel to it. A special layer of

these, arranged as a basement membrane under the surface epithelium, can be distinctly seen in many places. Outside the epithelium of the glands a basement membrane is also found.

6. In the superficial portions of the mucosa, the capillary junctions of the arteries and veins are the only vessels usually found.

7. The line of junction of mucosa and muscular wall is an irregular one. There is no special muscularis mucosæ.

CHAPTER II.

DECIDUA VERA.

The earliest specimen of decidua vera of which there is record is that described by Peters, of Vienna. He obtained a pregnant uterus from a woman who poisoned herself with caustic soda on October 1, 1895. Her last menstruation had occurred during the first week of September. The pregnancy was probably not more than five or six days advanced. The uterus was softened and somewhat enlarged. The mucosa was thicker on the fundus and posterior wall than on the anterior. On the former it measured 8 mm. and on the latter, 5 mm. Toward the os internum it became thinner. Many furrows were present. The ovum was embedded in a three-sided prominence about the middle of the posterior wall; it formed no projection, but was marked only by an area paler than the surrounding congested mucosa. The vera was thicker in the region of the ovum than elsewhere.

Leopold has published a specimen slightly older than that of Peters. It was taken from a multipara, August 29, 1887. There was cancerous disease of the cervix, and total extirpation of the uterus was performed. The patient's previous menstruation lasted from August 14 till August 19.

The whole mucosa was deeply congested and much thickened. The thickening was most marked on the posterior wall, where the ovum was implanted about 7 mm. below the fundus. At this spot there was a slight rounded elevation, 8 mm. in width. The vera varied from 5 to 9 mm. in thickness, save at the os internum, where it was only about 2 mm. The thickness of the mucosa under the ovum (Serotina) was 4 mm. The surface of the vera was irregular, being divided by slight furrows into small areas.

In another specimen, believed by Leopold to be about fourteen days old, the surface of the vera showed a fine network of little furrows and was deeply congested. The lower limit of the vera, near the os internum, presented a wavy appearance. The thickness was 4 to 5 mm. on the average; at the edge of the ovum it measured 6 mm.

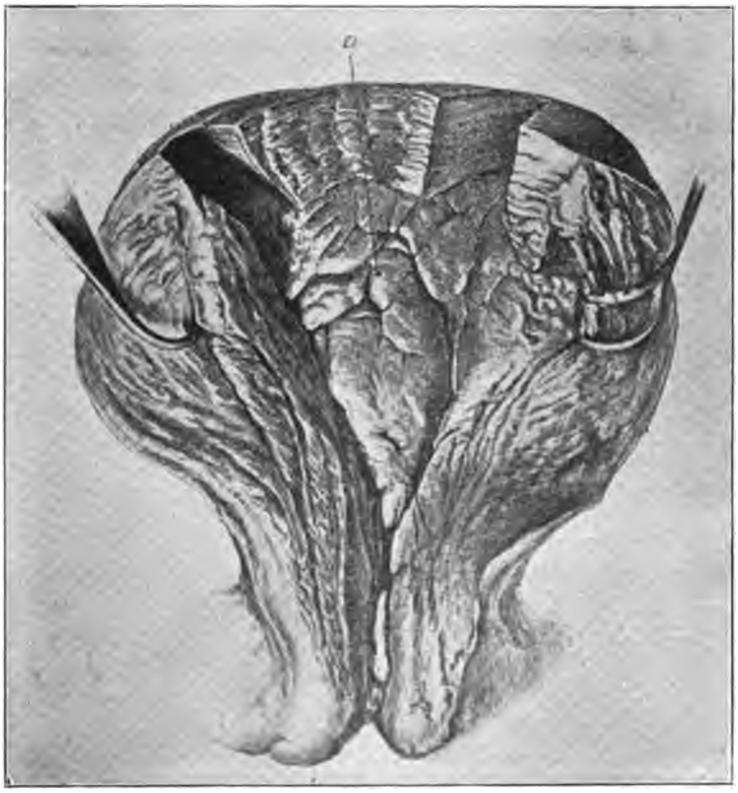

FIG. 1.—Pregnant uterus in second half of first week. The cavity has been laid open, showing the altered condition of the mucosa. *Ei* marks the site at which the ovum is imbedded. (H. PETERS.)

The distinction between compacta and spongiosa was easily seen. In both was a plexus of dilated capillaries, especially marked in the former. On the surface was cubical epithelium.

In Reichert's specimen, believed by him to be twelve or thirteen days old, the appearances were as follows:

The mucosa of the body was swollen and divided by furrows into a series of flattened or rounded areas of different sizes. This condition did not exist in the cervix, the lower edge of the vera forming a ridge above the os internum which gave it a distinct boundary. The openings of the Fallopian tubes were visible. The areas of the anterior wall were distinct from those of the posterior wall; a furrow, which ran down the side wall, separating them. It was evident that the lateral parts of the mucosa had not increased in thickness to the same degree as that of the anterior and posterior walls. The number of areas on each of these walls was eight.

The whole vera was triangular, the lower end being truncated. The base measured 3 cm., the vertical distance from base to apex 2.7 cm. In the uterine cavity was a small amount of milky fluid (probably mucus). Reichert thought that this served to keep the walls apart. This is probably the case. It is very likely due to increased activity of the glands in the early stages of congestion of the mucosa.

In comparing this specimen with others of a later period, Reichert found that the arrangement of the areas was a variable one, but that at each angle of the mucosa there was a pretty constant similarity. Thus, on both walls at each upper angle a somewhat triangular area was found, while at the lower angle a vertical furrow was pretty constant, giving rise to two areas of rectangular shape.

In his earliest specimen three other areas were irregularly polygonal. Another was rounded, and to this the ovum was attached. The surface of the areas was flattened or slightly rounded, and was subdivided by numerous slight furrows which varied in depth. After the specimen had been placed in spirits of wine, Reichert noticed that the small subdivisions of the areas presented the appearance of a mass of small hillocks or papules! (This latter appearance must, therefore, be regarded mainly as an artificial formation caused by the spirit.)

In the fresh abortion sacs, in the third, fourth, and sixth weeks of gestation, which I have studied, the appearance of the inner

surface of the vera is much the same as that described by Reichert. After careful graduated hardening there was practically no change, like that produced when sudden hardening in methylated spirits was employed—*i. e.*, no such shrinkage was produced.

The appearance of the early decidua, it is interesting to note, is the same as that found in the uterus in ectopic gestation, as described by Abel, myself, and others.

In the early abortion-sacs which I have examined, the naked eye appearances of the surface of the vera were very like those described by Reichert in his twelve-day specimen. Minot found a similar condition in his four-weeks pregnancy case.

I noticed that the mouths of the glands were best seen in the furrows—*i. e.*, in the least developed parts of the vera. On the surface of the raised portions they are seen more rarely after the first week or two of pregnancy. We shall later find out that the reason of this is the obliteration of many of the outer parts of the glands by the pressure of the rapidly increasing interglandular elements of the compact layer of the mucosa.

In six-week specimens the surface of the vera is somewhat altered. It is not so markedly irregular, but more uniform, probably owing to the gradual obliteration of some of the deep furrows by the development of decidual tissue below them. I have also noticed this, as has Eugen Fränkel, in earlier abortion-sacs. The microscopic appearances presented at different periods I now give in detail.

DURING THE FIRST THREE WEEKS.

In Peters' early ovum the following appearances were found. The surface epithelium was intact, the cells being lower than in the non-pregnant condition. Near the ovum the glands were most altered, their outer ends being somewhat stretched, the epithelium being less columnar than in the deeper portions. In the lower mucosa glandular hypertrophy was noted in various degrees, many lumina appearing irregularly stellate on transverse section. Many lumina were widened. In this increase there was clearly a development of the small basal cells lying between the columnar ones. At

intervals gaps were seen between the cells, and they were separated from the basement membrane in places. Cilia were often absent. In some sections masses of cells lay free in the lumen.

Edema of the interglandular tissue was noted, especially near the ovum; the increased thickness of the mucosa in that region being largely due to this. In general this tissue was the same as in the non-pregnant state. The compact layer showed slight hypertrophic changes in the interglandular tissue of its outer part. The nuclei in its cells were larger. Distinct evidence of decidual cells was found only near the ovum. The nearer the ovum the more blood-corpuscles were found between the connective tissue cells.

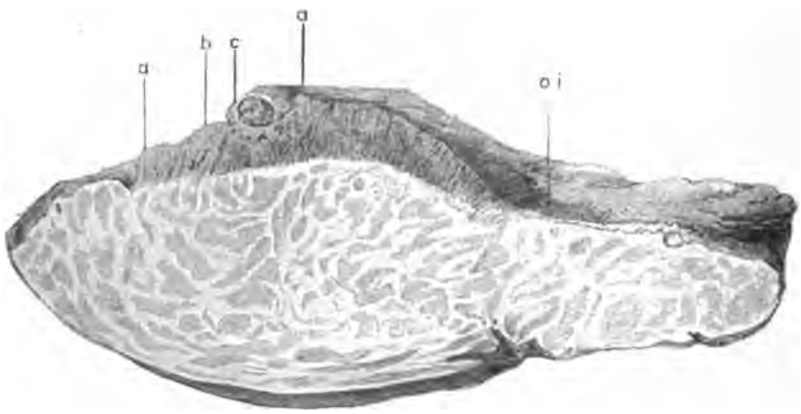

FIG. 2.—Section through posterior wall of uterus with ovum of about seven days.—(LEOPOLD.)

The decidua is 4 mm. thick at fundus *a*, increases to 6 and 8 mm. *b*, *c* beside ovum, to 9 mm. below it *d*, and continues about 8 to 6 mm. thick down to os internum *o i*. Beneath the ovum the serotina is only 4 mm. thick. The mucosa of the cervix, beyond *o i*, is not altered.

and the more marked the edema. Mitoses were not noted, though many cells had two nuclei, possibly, an evidence of direct nuclear division. There was no indication that white blood-corpuscles took part in the formation of decidual cells. Many capillaries were enlarged in the compacta. In Leopold's early case, on microscopic section, the glands were found to be elongated, wavy or spiral in their course, and lined mainly with cubical epithelium. In their lower portions they presented foldings and diverticula. Few de-

cidual cells were present, and mainly in the compacta. The superficial epithelium was cubical.

Merttens has made a careful study of scrapings of the uterus in a case of early pregnancy. He considered it to be eight days old, but it is decidedly more advanced. He noticed the division of the vera into compact and spongy layers. In the latter the gland spaces were enlarged. The long diameters were for the most part slightly oblique to the surface. The epithelium covering the mucosa was cylindrical, the general surface outline showing irregularities. In the outer parts of the glands the epithelium stained more deeply than in the lower parts, and it was somewhat less columnar. The basement membrane was easily seen.

Decidual cell-formation had begun in the outer part of the compact layer, but not in the spongy layer.

In Reichert's early case, unfortunately, no careful microscopic study was made. It was noted that the surface had changed from the columnar to the cubical type and that the cilia had disappeared.

DURING THE FOURTH AND FIFTH WEEKS.

I have examined abortion-sacs at these periods of pregnancy. As the information to be derived from them regarding the vera is only partial, I shall give no complete description of them. They show transitional stages between the earliest conditions and that found at the sixth week. I shall, therefore, only refer to them in connection with the following description of the vera, from a case in which the whole pregnant uterus was examined. Minot has described a case in which pregnancy had advanced one month.

DURING THE SIXTH WEEK.

The vera varies from 3 to 7 mm. in thickness. The distinction between compacta and spongiosa is readily made out. The latter may be subdivided into an outer portion where the glands are only slightly branched, and a deeper portion where the numerous sections of the branched ends of the glands give rise to the spongy appearance proper.

Lining Epithelium.—This is still to a great extent present, though somewhat altered. Statements have been made to the effect that it is absent at this period. These are probably based upon the examination of sections that have not been fresh nor carefully hardened. Under such conditions the epithelium may soon disappear. The columnar cells are now cubical or even more flattened in parts. Their nuclei are rounded, or flattened somewhat parallel to the surface of the decidua. The cilia have entirely disappeared. Here and there strips of epithelium or individual cells may be found detached from the surface. In some parts the cell-substance has greatly disappeared, the nucleus alone being left. Nuclei, also, may be found in various stages of degeneration. The probable cause of degeneration in the covering epithelium is the rapid growth of the interglandular cellular tissue giving rise to decidual structure and so causing stretching, flattening, and separation of the superjacent epithelium, which does not take part in the development.

Glands.—The glands have increased in size, but I can find no evidence that new ones have been formed. They differ in size, shape, and arrangement from those in the non-pregnant state. One marked feature is the narrowing and obliteration of the portions occurring in the compact layer owing to the lateral pressure of the surrounding growing decidual tissue. The obliteration of the mouths of the glands is especially marked in the elevated areas of the vera.

The deeper portions of the glands are enlarged in size in most cases, so that the spongy nature of the lowest part is more prominent than in the non-pregnant state. In many parts the spaces show a tendency to be arranged with their long axes nearly parallel to the surface. This suggests the explanation that, as increase in the size of the mucosa has occurred, the pressure of the intra-uterine contents against the mucosa has forced the enlarging glands to become arranged in this manner.

The glandular epithelium is greatly altered. Only rarely is it found of normal columnar shape. In most parts it has become cubical or even more flattened. As a rule one finds that the great-

est changes are most marked in the outermost divisions of the glands. In many the cells are largely shed, either in large masses or in small groups. The cast-off cells show various stages of degeneration. The outlines become irregular. In some the protoplasm becomes finely granular; in others it is swollen, staining lightly. Here and there masses are quite changed into hyaline material. In several gland-spaces, leucocytes have passed through the wall and are found among the degenerating cells.

The explanation of this great alteration in the glandular epithelium is not very apparent. The appearances suggest the prominence of a mechanical factor. The gland walls are stretched unduly as a result of the increase in the interglandular elements and the epithelium consequently becomes stretched and separated, gradually becoming cast off into the gland lumen, undergoing degeneration.

Interglandular Tissue.—The most marked change in this tissue is the development of the decidual cells. This has undoubtedly begun in the outermost layer of the mucosa. At this period of gestation it is almost, though not entirely, limited to the compact layer and is most advanced in the outer part. The trabeculæ of the spongy layer are, for the most part, thinner than in the non-pregnant state. Occasionally may be seen a large solid mass of connective tissue elements lying like an island in the midst of the spongy layer.

The structure and arrangement of the decidual cells are of a varied nature. Some are rounded, others oval, others polygonal, others spindle-shaped. (Many of these appearances are simply due to the different planes in which the cells have been cut.) The nuclei are large and somewhat rounded. In most places the cells are connected by broad or slender processes. In some parts no processes can be seen. Sometimes the spindle-shaped cells lie in compact bundles, the individual units appearing to be distinct from one another. Occasionally similar bundles may be found torn up by blood extravasation; the processes connecting many of these cells can, as a result, be easily traced. Near the surface of the vera

the cells are for the most part arranged with their long axes parallel to it.

From these appearances it is evident that the nature of the change from the non-pregnant condition has been that of marked hypertrophy of the pre-existing embryonic cellular elements, both nucleus and cell-matrix having become enlarged. The proportion of the latter to the size of the nucleus is much greater than in the non-pregnant state. That hyperplasia also occurs seems to be certain. Actual cell-division can be distinguished in parts. It is probably due to this process that in many places the decidual cells are found with more than one nucleus. No attention need be paid to the views of Hennig, Ercolani, Langhans, and others, that the decidual cells develop from leucocytes; nor to those of Friedländer, Frommel, Ayers and others that they arise from the epithelium of the glands and from that on the surface. These opinions must be entirely abandoned.

Blood-Vessels.—The condition of the vessels varies greatly. In the compact layer in some parts there is enormous dilatation of the capillaries and also some increase in size of the small arteries and veins communicating with them. As a rule the dilated capillaries which form the large blood spaces are lined with a single layer of flattened endothelial cells. Around the vessel the decidua has generally a compressed appearance, the cells being flattened parallel with the walls.

In other parts, there is only a moderate increase in the size of the capillaries, and in others scarcely any is found. Here and there small extravasations of blood are found in the decidual tissue. They may be found localized or diffused through a small area, having dissected the cells from one another.

Eden states that an essential change in the formation of the early vera is extensive rupture of blood-vessels, just as in menstruation. In fact, he is of the opinion that decidual formation takes place in the uterus which has recently menstruated, owing to the influence of conception. I cannot at all corroborate his statement

as to hemorrhage. In normal cases I believe it to occur only to a slight extent.

There is no proof that menstruation is necessary to the fixation and growth of the ovum. I have fully discussed this matter in my work on ectopic pregnancy, and have pointed out that pregnancy may occur in a girl before the onset of menstruation, during lactation when there is no menstruation, during periods of amenorrhœa at the menopause and in diseased conditions of the body, and in the rudimentary horn of a malformed uterus in which menstruation has never occurred.

Moreover, it is to be remembered, menstruation does not occur in the great mass of mammalians, the fertilized ovum entering into relationship with the normal unaltered mucosa.

DURING THE SECOND MONTH.

The vera has been carefully studied at this period by Gustav Klein. The description given by him is very like that which I have given for the sixth week. He noticed that a good many of the gland-spaces near the muscular layer of the uterine wall still contained columnar epithelium very little altered, but that near the serotina it was more changed. Doubtless variations occur in different specimens in regard to the rapidity with which changes occur.

According to G. Klein, the highest stage in progressive development is reached by the vera at the end of the second month. I do not think any very definite period exists, though it is undoubtedly between the second and third months as a rule. I have, however, noticed slight degenerative changes in the decidual cells at the sixth week. This is probably exceptional.

DURING THE FOURTH MONTH.

The thickness of the vera varies considerably—from 2 to 5 mm The compact layer is relatively thinner than it was at the second month. All traces of surface epithelium have disappeared. The cells lining the glands in the compact layer have been cast off into

the gland-lumen and, in parts, have disappeared. In the spongy layer the gland spaces are very large, and are to a great extent elongated parallel to the muscular wall. This is due probably to compression of the decidua by the intra-uterine contents along with a process of stretching due to the increasing size of the uterus. Only in a few places can a gland-end be found, close to or between the muscular bundles, with a well-marked lining of epithelium. The cells are no longer columnar, but cubical. In most of the spaces the epithelium lies in the lumen in various stages of degeneration, and, in some cases, mixed with blood. In many spaces the cell débris has entirely disappeared. The connective tissue elements are also altered in appearance. In general there is a tendency to flattening of the cells, so that they lie more or less parallel to the surface. Many of them are thus spindle-shaped. This is especially seen in the compact layer. In some parts the cells appear closely packed together. Here and there are groups of decidual cells like those found at earlier periods, though, as a rule, they are of smaller size. The cell-outlines are indistinct and the matrix has a swollen appearance, taking on the ordinary stains lightly. In a good many places vacuolation is found both in the nuclei and in the cell matrix. It seems as if in certain parts the tissue had returned to an embryonic mucoid condition, or had not advanced much beyond it. In parts cell-division is found.

Leucocytes are found scattered in varying numbers. In the spongy layer the interglandular trabeculæ are greatly thinned. Some of them are broken across, probably due to the stretching resulting from the growth of the uterus and the disproportionate rapidity of growth in the decidua.

Blood-Vessels.—Sinuses are still found in the compact layer, but they are smaller and less numerous than they were at the second month. In some thrombosis has occurred. In the spongy layer and also in the muscle several small arteries, and probably also veins, are seen in which the intima is greatly thickened. This is due to swelling of the connective tissue elements or to proliferation of the endothelium.

Relation of Vera to Reflexa and Chorion Lœve.—The exact relationships between the vera and reflexa will be considered under the heading "Decidua Reflexa."

At this period of gestation, the thinned and degenerating reflexa may be found in parts lying close to the vera, perhaps pressed firmly against it. It is doubtful if extensive adhesion takes place. The line of meeting is an irregular one. In parts the reflexa is wanting and the chorion is in direct contact with the vera, whose elevations and depressions it follows. Here and there degenerated remains of the villi of the chorion lœve are found. Fuller details are given under the heading "Non-placental Part of Chorion."

DURING THE SIXTH MONTH.

The thickness of the vera varies from 1 to 3 mm. It is thus evident that during the preceding two months it has become somewhat thinned. The compact layer is especially diminished. The elongation of the gland spaces in the spongy layer and their parallelism with the surface is very marked. In several parts the trabeculæ of the spongy layer are pressed so closely together that no spaces exist. Only an occasional gland-end near the muscle can be found still lined with low epithelium. The decidual cells are, on the average, smaller than at the fourth month. They are in many parts closely packed together, their long axes being parallel to the surface. Cell-division can be found here and there. Vacuolation of the cells exists in several places. The blood-sinuses have to a great extent become obliterated. Several arteries show more marked changes in their inner coats. No reflexal remains can be distinguished. The chorion is in close relationship with the vera.

AT FULL TIME.

The vera is, on the average, slightly thinner than it was at the sixth month, measuring from .75 mm. to 2 mm. It is of interest to note that while the superficial area of the mucosa of the body has greatly increased, the thickness of the vera which measured at

the sixth week from 3 to 7 mm., at full time still measures from .75 to 2 mm. Had not some increase in the quantity of tissue occurred in the mucosa during this period, the thinning would have been much greater, and there might have been a breaking up of the mucosa. It must also be remembered that the spongy nature of the vera has allowed stretching to take place in it coincident with the increasing area due to development of the muscular part of the wall.

Both compact and spongy layers have undergone thinning, the former most of all. In some parts no compact layer worthy the name can be found. The decidual cells are arranged in pretty much the same manner as in the sixth month. There is an increased quantity of embryonic mucoid tissue. In many cells the nuclei are irregular and degenerated, being surrounded with very little matrix. In parts the cells are fused into a faintly staining mass, vacuolated irregularly, the nuclei appearing in various stages of degeneration. In many parts are groups of well-defined decidual cells, though there is a general tendency to the occurrence of swelling in them.

Near the placenta deeply stained cells are found whose nuclei are single or multiple, and also darkly stained. They are single, in groups or chains. They are also found in adjacent parts of the serotina and of the sub-epithelial layer of the placental chorion. Their nature I shall discuss later.

It is interesting to note that no deeply staining fibrin-like masses of degenerated decidua vera have been found by me in the decidua vera. As I shall show, this marked form of degeneration is found mainly in the serotina and reflexa. Of course occasionally fibrin may be seen in the vera resulting from old extravasated blood.

CHAPTER III.

DECIDUA REFLEXA, DECIDUA CIRCUMFLEXA, DECIDUA CAPSULARIS. DURING THE FIRST TWO WEEKS.

The nature of the decidua reflexa has been the subject of much speculation. John Hunter's original description of its formation by the pushing inward of the vera as the fertilized ovum passed through the uterine end of the Fallopian tube, has long been abandoned. There is a tendency, at the present time, to give up the use of Hunter's term "reflexa" and to substitute for it "circumflexa" or "capsularis;" the latter being merely descriptive and not suggesting any method of development.

Very widely held has been the view that when the ovum became attached to the vera a projection of the latter grew up around it, until it formed a complete investment.

More recently, it has been thought by several that as the ovum attaches itself to the growing vera, the latter continuing its development soon surrounds and envelops the former, the reflexa being therefore, the superficial part of the vera which has grown above and over the ovum.

These and other views have been entirely speculative, the earliest stages never having been observed in the human female.

Hubert Peters' specimen is of the greatest interest in connection with the origin of the reflexa, because it is the earliest stage yet secured. The area of the reflexa was not elevated above the general surface of the island of mucosa. On surface view it was paler than the surrounding decidua. The ovum was entirely sunk in the compact layer of the vera. Over each side was an extension of the latter forming the outermost portion of the reflexa; the central portion was made up of a mass of blood-fibrin. The ovum in this case, therefore, was not completely invested with decidual tissue.

Peters has laid great stress on the absence of any prominence of the mucosa at the site of attachment of the ovum and he points out that the same condition existed in Ahlfeld's and Reichert's early pregnancies. It is to be noted, however, that in Leopold's early case (later than Peters', and earlier than Ahlfeld's and Reichert's) there was a surface projection. While, therefore, as a rule the reflexa is not elevated above the surface until after the second week, it is evident that it may sometimes take place earlier. The

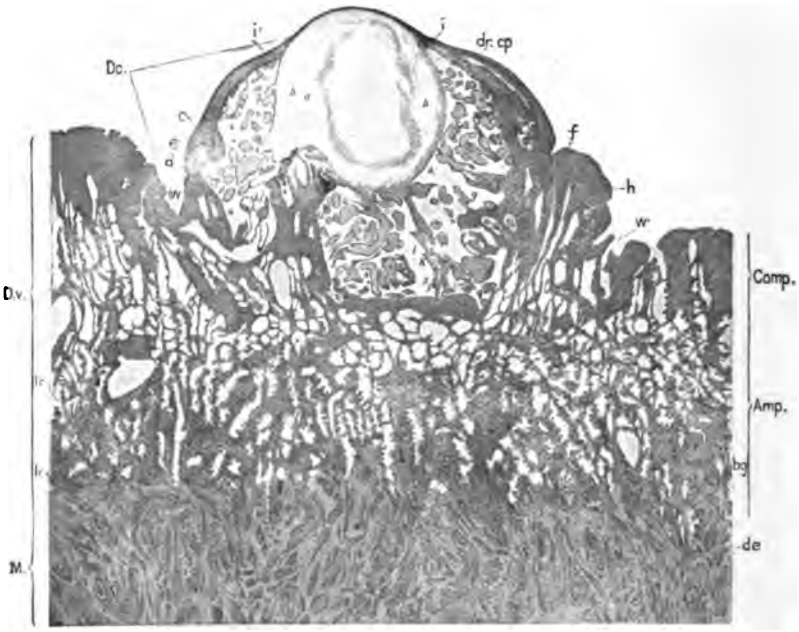

Fig. 3.—Microscopic section through ovum of about seven days, embedded in decidua.– (Leopold.)

_M_, muscular wall with ends of glands (_d e_) in it; _D v_, decidua vera divided into compact (_Comp._) and spongy (_Amp._) layers; _l c._ leucocytes in the lymphatics. The mucosa rises at _w w_ round ovum to form the Reflexa (or decidua capsularis _D c_). In this, up to _d r c p_, gland spaces are seen; above _i i_ it consists mainly of _fibrin_. The ovum _b b_ is resting on a spur of decidua. In the space between it and the reflexa are chorionic villi and processes of decidua; and into this space a vessel opens at _c_. Opposite _h_, a villus is becoming rooted.

explanation of such variations is not evident. In Leopold's case it may be that the ovum is perched on a ridge of decidua and thereby prevented from sinking down as it normally should.

Peters' view as to the origin is as follows: When the young ovum becomes attached to the mucosa, it rapidly sinks into the compacta, thereafter continuing to excavate laterally as well as deeply. The overhanging portion of the mucosa forms the reflexa, the gap through which the ovum entered being closed by the organization of blood-clot. The latter area is, therefore, of fibrinous nature. He regards this observation of great importance, especially in explanation of the microscopic appearances found in the polar portion of the reflexa later in pregnancy, viz., abundance of fibrin, absence of decidual cells and glands. It seems to me, however, that Peters has laid too much stress on this point. In his specimen the fibrin-area is very minute; in later specimens the polar portion of the reflexa above referred to is very much larger. This is due, as I shall later show, to degenerative processes taking place in that portion of the reflexa most distant from the vera.

Peters' view as to the origin of the reflexa in his specimen can not be doubted. The irregular inner surface and the absence of epithelium on it such as there was on the outer surface were an additional corroboration. This epithelium was cubical near the base, but more flattened toward the free edge (near the fibrin-plug), the nuclei being parallel to the surface. The edge was crumpled in places and detached cells of the covering epithelium were lying in the fibrin. In the basal portion were sections of glands, lined with cubical epithelium, lying somewhat tangential to the convex surface of the ovum.

The interglandular tissue was the same as that of the serotina. Among the small ordinary connective tissue cells were a number of large deeply stained cells, which were either decidual cells or extensions of the fetal trophoblast into the decidua.

The tissue was edematous; extravasation of red and white blood-corpuscles, congestion of capillaries and formation of new vessels were noted.

The gap in the center of the reflexa consisted of effused blood in which fibrin-formation was in progress. In the fibrin were many spaces; numerous blood-corpuscles were degenerated. Detached

pieces of fetal trophoblast of various sizes were also scattered through the clot. On the inner wall of the reflexa and fibrin-layer were processes of fetal trophoblast, and between them blood-spaces filled with maternal blood.

In Leopold's earliest specimen the reflexa consisted of an apparently uniform tissue completely surrounding the ovum. The outer polar portion was very thin, but showed no break; it was composed of fibrin, but there was no epithelium on its surface, nor were there any glands. In the basal part of the reflexa, there were all the elements found in the neighboring serotina, *e. g.*, decidual tissue, glands, etc. The glands were much drawn out. The uterine epithelium was absent from the outer surface, nor was there any on the inner surface.

Keibel in a second week specimen found a stellate-shaped transparent area in the outer polar part of the reflexa. The tissue contained no glands, decidual cells, blood-vessels, nor surface epithelium.

In Breus' second week specimen the structure was fibrinous (though he thought a thin decidual layer covered it).

Von Spee agrees with Peters that the outer portion is entirely fibrinous.

In Reichert's early case very few details are given. At the outer polar portion there was a depressed area of the reflexa, 3 mm. in diameter, which was very thin. It contained no glands nor any decidual cells. This area has been termed Reichert's scar.

It was believed by Reichert to mark the recent closure of the reflexa over the ovum. The outer surface of the swelling was smooth and free from glandular openings over its great extent. Only near the junction with the vera was the surface irregular and marked with gland-orifices. Reichert believed that that part of the vera to which the ovum was attached grew less rapidly than the surrounding portions, and that, therefore, the ovum became easily imbedded by the upward growth of these portions.

Schwabe has also described the reflexa in an abortion case of the same period of gestation. He found that the outer surface of the

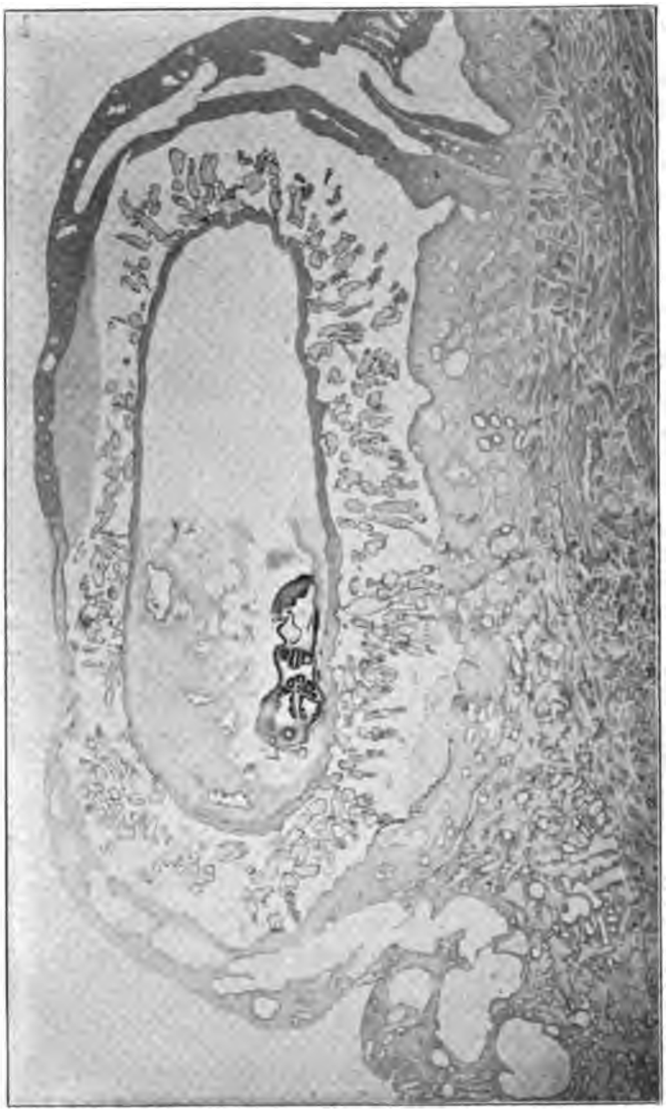

FIG. 4.—Section through the wall of the uterus in the early part of the third week of pregnancy (believed by Leopold to be about the fifteenth day). The ovum is shewn in relation to the decidua serotina and reflexa; *c*, blood-sinus in compact layer of decidua; *m c*, opening of sinuses into intervillous spaces; *d*, glands of mucosa; *bl* blood-extravasation in the decidua; *st*, villus-stem. (LEOPOLD.)

reflexa was still mainly covered with epithelium continuous with that on the vera, though considerably more flattened. On the inner surface the epithelium was wanting.

BETWEEN THE THIRD AND FOURTH WEEK.

Eugen Fraenkel has studied the reflexa at this period in an abortion case. The width of the sac at the base was 16 mm. In height it measured about 10 mm. It consisted of a thick basal portion and a thin polar portion. On the outer surface of the basal portion, near the junction with the vera, several gland-orifices were noticed; and in the wall near the surface, many blood-sinuses were noticed like those in the neighboring parts of the vera, only smaller. The inner half of the wall was free from these and very largely from glands, and therefore was more compact. The decidual cells toward the inner surface appeared more compressed than in the outer part, Here and there blood-extravasions were found in the decidual tissue. Some of the glands could be seen passing down toward the vera or serotina.

Here and there on the inner surface a blood-space could be seen opening into the intervillous spaces of the chorion læve. At the mouth the endothelium was more or less absent. The thin polar portion of the reflexa had no regular structure. The decidual cells were mainly round or oval, and arranged in irregular groups. Small blood-spaces were found throughout, mainly in the middle portion. Very few remains of glands were found. (Selenka found in the reflexa of *Hylobates,* glands scattered throughout the reflexa.) Degeneration had commenced in the outer polar portion. Its innermost part was a fibrinous-looking layer which here and there extended into the substance of the wall. In one part the same change was found on the outer surface.

AT THE SIXTH WEEK.

The appearances presented are considerably like those just described. The distinction between the basal and polar portions can be made out. The basal part can be divided into an inner compact and an outer spongy layer, the latter containing gland-spaces vary-

ing in number in different places. They are not at all as numerous as in the spongy layer of the vera or serotina. They are lined with cubical epithelium in parts. Here and there it is cast off into the lumen. As a rule, these spaces are elongated in a direction parallel to the surface of the reflexa; a few are nearly perpendicular to it, however; some can be traced downward for a long distance into the substance of the serotina or vera. I find none opening on the inner surface of the reflexa and very few on the outer surface. Toward the pole the glands disappear, and at the extreme portion only occasionally can a trace of one be found.

Throughout blood-spaces are found. They seem to vary considerably in distribution. Here and there extravasations have occurred into the decidual tissue. It is found in fresh masses or changed to fibrin. Occasionally some blood can be found in a gland-space. In the basal portion I have found a few blood-spaces communicating with the intervillous spaces of the chorion læve. In one or two instances extending into the vessel are masses of syncytium or nucleated plasmodial fetal epiblast.

Degeneration has advanced considerably in the reflexa. The innermost part of the wall is the seat of a layer of fibrin-like material of irregular thickness and arranged in a sort of reticulum or as a uniform mass. This layer is thickest at the pole. This change is apparently a kind of coagulation-necrosis in the decidual tissue, though some of the surface layer may be fibrin formed from blood. Similar smaller pieces of degeneration may be found in the substance of the wall, mainly in the inner portions, very rarely in the outer. Here and there numerous leucocytes are found in their neighborhood. In a few cells division may be seen. In several places the decidual cells appear to have become fused, the blended cells having a swollen, homogeneous appearance and taking on only a faint stain. Eugen Fraenkel has also noticed this. Possibly this condition is the earliest stage of the fibrinous degeneration.

On the inner surface of the reflexa no trace whatever of maternal epithelial cells can be found. (The relation of the inner surface to the chorion will be afterward considered.)

On the outer surface, for a short distance next to the vera, very much the same condition is found in the epithelium as on the neighboring part of the vera. Nearest the base the cells are of low cubical shape and fairly regularly arranged. Farther out they are more flattened, more degenerated, with breaks in their continuity. Still farther out they have mostly disappeared.

DURING THE SECOND MONTH.

Several specimens have been carefully described by E. Fraenkel and one by Minot. At this period the chief change noticed is the increased fibrinous degeneration. Fraenkel describes also a good deal of blood-extravasation in the decidual tissue.

DURING THE THIRD MONTH.

By this month the perional space is mainly obliterated. The reflexa is in contact with the vera, though not adherent to it. It has become thinner, and the great mass of it is altered so that the original cellular structure can only be well made out near the base. The cells are broken down and blended into a structureless mass, the fibrinous or hyaline change having spread throughout the greater part. Many leucocytes are found.

AFTER-CHANGES IN THE REFLEXA.

It has been generally taught that the reflexa blends with the vera, and that it more or less forms the inner layer of the latter during the advanced months of pregnancy.

Minot and E. Fraenkel have cast doubt upon this view, and my observations go to support them. During the fourth month, I have found that the reflexa while in some parts distinguishable as a thin, almost complete fibrinous or hyaline layer lying in contact with the vera, is, in others, entirely absent, the chorion læve lying against the vera. At this period there is scarcely any degeneration in the vera proper, and it is, therefore, quite easy to distinguish the vera from the reflexa.

During the fifth month traces of the reflexa may also be found in parts. During the last three months very scanty traces of the reflexa can be distinguished. They are recognized as small portions of

fibrin in which occasional remains of degenerated villi are found.

As to the nature of the degeneration, it is evidently a kind of coagulation necrosis as a result of which cell-substance and nucleus become quite destroyed. It has long been held that there is fatty degeneration. I have not been able to find any evidence of such a change. The work of G. Klein, E. Fraenkel and others seems to have sufficiently disproved the long-held view. There are appearances which certainly resemble fatty degeneration, but no fatty reactions can be obtained. These appearances are really caused by vacuolation, which may occur either in the nucleus, or in the cell-substance, or in the fused hyaline cell-masses.

As to the primary determining cause of the necrotic changes it is impossible to speak with certainty. It is doubtful if it may be related to imperfect blood-supply. At first the reflexa is richly vascularized, and one would suppose that even the distal polar part would be well nourished. Possibly, owing to the great multiplication and growth in size of decidual cells, giving rise to the compact decidual tissue, the lymph-spaces are to a large extent obliterated, so that gradual death may be set up at various points. Possibly also, this change is further assisted by the presence of blood effused in different parts of the reflexa. Possibly also, the circulation is slowed by the outward pressure of the rapidly-growing ovum.

It is interesting to inquire what is the relation of this hyaline or fibrinous degeneration to the chorion læve. Fraenkel believes that, as the change is generally found first on the inner surface of the reflexa, it is probably secondary to the early degenerative changes in the villi of the chorion læve. Possibly the relationship is only one of association, both reflexa and villi degenerating from causes inherent to themselves.

There is yet another possibility which I shall afterward consider, viz., that the degenerate condition of the reflexa is the occasion of retrogression in the villi related to it, *i. e.,* as there is no stimulus to increased growth and vitality in the villi of the læve, owing to the non-active condition of the reflexa, and as they come into relation only for a short time with a very small quantity of

blood, they therefore do not functionate to produce hypertrophy but slowly undergo retrogressive changes.

In certain cases in which there is abnormal growth and continuance of the chorion læve, forming the so-called reflexal placenta, there seems to be an exceptional development of the reflexa from the very beginning, while the degenerative processes are probably much less marked than in ordinary cases. In a four-months case, in which there was a reflexal placenta, I found that there was very little of the fibrinous degeneration though a good many cells were vacuolated.

Apart from the intrinsic tissue changes directly related to degeneration of the reflexa, it must not be forgotten that there is probably some part played by the mechanical stretching due to the increasing ovum. Van Tussenbroek has especially insisted upon the reduction of the decidua reflexa by mechanical pressure.

As to the part played by the decidual reflexa, it seems mainly to fix and steady the ovum during its early life while the placental circulation is being established. It probably also furnishes a little nourishment to the ovum through the chorion læve, but this is of very minor significance and of brief duration.

CHAPTER IV.

DECIDUA SEROTINA. NATURE OF PROGRESSIVE CHANGES IN THE DECIDUA.

The decidua serotina is that part of the vera lying between the muscular layer of the uterine wall and the ovum; to it the latter is attached and in relation to it the placenta is ordinarily developed. The term "Serotina" (meaning "latest formed") was used by John Hunter because he believed it to be that part of the decidua which developed under the ovum when the latter had pushed the vera in front of it. He regarded it then as the last formed decidua. As this view is not now held, there is a tendency to displace the term "Serotina," using "Basal" or "Placental" instead.

DURING THE FIRST MONTH.

In Peters' specimen the serotina was edematous and congested, extravasated white and red blood-corpuscles being noted. In the compacta dilated capillaries and blood-spaces were seen. Some of the latter had endothelium on their inner wall; in others it was wanting. Some of these blood-sinuses communicated with lacunæ between processes of trophoblast extending outward from the ovum (to be considered afterward). Nowhere in the compacta were any arteries noticed. Any appearance of adventitia was due to connective tissue cells arranged around the capillaries. Some of these were continuous with spiral arteries running in the spongiosa. Some of the blood-sinuses were continuous with venous channels.

Proliferation of endothelium, such as has been described by me as occurring occasionally in tubal pregnancy, was nowhere visible. (This has been noticed in several mammals and has been mentioned by Frommel, Duval and Hubrecht.)

In some sinuses the endothelium was degenerated or separated from the wall—probably associated with extreme or rapid distension of the vessel. Here and there where the trophoblast extended close

to a sinus the endothelial lining was pressed against the fetal tissue giving an appearance as if the latter were thus being accidentally covered. In some sinuses masses of syncytium and trophoblast had entered the lumen. Nowhere did maternal endothelium penetrate the blood lacunæ in the trophoblast, nor was there any transformation of endothelium into syncytium.

Near the trophoblastic processes new formation of maternal capillaries of endo-cellular origin was noticed and, also, degeneration of some of the new-formed endothelium.

In the compacta were numbers of large polymorphic cells. The cell-substance was finely granular. The nuclei were polymorphic and stained deeply; in some instances, lightly. They often contained masses of chromatin, being very different from the fine network of the unaltered cells of the connective tissue. Some of the nuclei looked like agglomerations of small masses. Peters thought that some might be masses of red blood-corpuscles.

He regarded these cells as the beginning of decidual cell-formation (though it is possible that they belonged to the trophoblast). The difficulty of establishing the nature of these cells is great and has been experienced by different observers. Hubrecht encountered the same trouble in studying the pregnant uterus of *Erinaceus*.

In the serotinal glands loosening and degeneration of the lining epithelium were noted. In some cases the lumen was filled with blood; in others syncytium or trophoblast had entered it.

There was no evidence of transformation of maternal epithelium into syncytium. Nor did gland-spaces contribute to the formation of the intervillous space.

In Leopold's early specimen the conditions were as follows:—

The serotina measured 4 mm. in thickness, being about one-half the neighboring vera. At one point the compacta rose as a ridge, on which the ovum sat, the space on each side being filled with villi. On its summit was a superficial layer of fibrin. On the sides maternal vessels comunicated with the intervillous spaces. Several smaller elevations of the compacta were noted.

Most of the glands in the serotina retained their epithelium; in

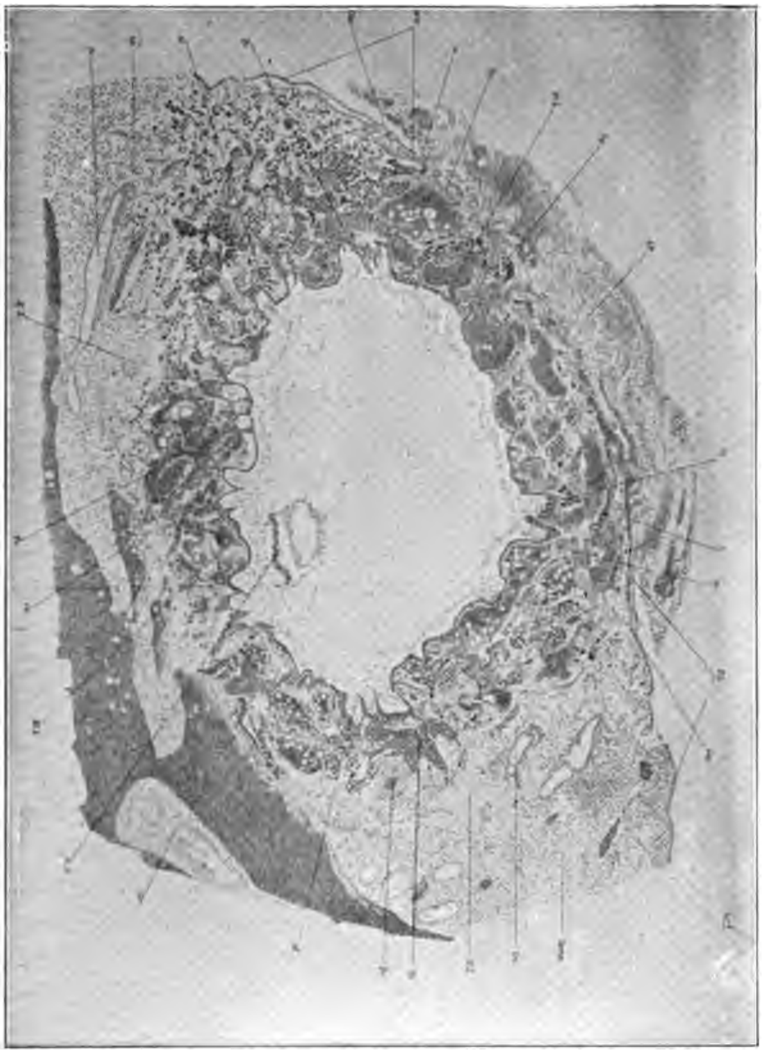

FIG. 5.—Section through ovum imbedded in the mucosa. Second half of first week of pregnancy. The largest diameter of the chorionic vesicle is seen. *G P*, blood-clot lying on the outer polar portion of the chorionic vesicle; *a b*, edges of break in mucosa through which ovum has entered; *U E*, uterine epithelium; *ap*, decidua reflexa; *Tr*, trophoblast; *Ca*, maternal capillary; *Dr*, gland in mucosa; *BlL*, lacunæ in the trophoblast containing maternal blood; *K A*, site of embryo; *Comp*, decidua compacta; *M*, mesoblast.—(H. PETERS.)

the compacta it was cubical, and in the spongiosa somewhat rounded. The lumina in the compacta were rather large and compressed by the ovum from above downward. In the spongiosa they presented an irregular and serrated outline. Enlarged connective-tissue cells were noticed and also giant-cell multinucleated masses (probably fetal).

In Reichert's early specimen no details of any importance are given regarding the minute structure of the serotina. In Mertten's early specimen (supposed by him to be 6-8 days old), to which I have already referred, he made out the following points: The compact layer had an average thickness of .35 mm. The outer parts of some of the glands were obliterated. The glands were lined with epithelium, in some parts columnar, in others cubical. In the compact layer large decidual cells with one or two nuclei were found, many being spindle-shaped and arranged parallel to the surface. At the surface was a layer, shaped like a half-moon, staining deeply red with eosine, evidently of fibrinous or hyaline material. In the compact layer were found many sinuses, round, oval, or irregular, containing blood. Here and there were found nucleated plasmodial masses among the decidual cells. In some cases these were extending down from the surface. In several instances they had pierced the walls of blood-sinuses. In the spongy layer the gland-spaces were increased in size. They were lined with columnar or cubical epithelium, which, in many places, appeared somewhat swollen, staining lightly. The spaces were large, oblique or parallel to the surface. In the outer part of the spongy layer some decidual cells were noticed. Here also were found irregular strands of deeply stained plasmodium. On the surface of the decidua was an irregular layer of the same tissue, which was continuous with the outermost epiblastic covering of the villi; and from it the masses extended into the decidual tissue. This plasmodial tissue, or syncytium, as I shall afterward show, is entirely of fetal epiblastic nature. Merttens wrongly considers it to be maternal in origin.

As I have already stated, Merttens is very likely wrong in considering this specimen to be only 6-8 days old. It is probably several days older.

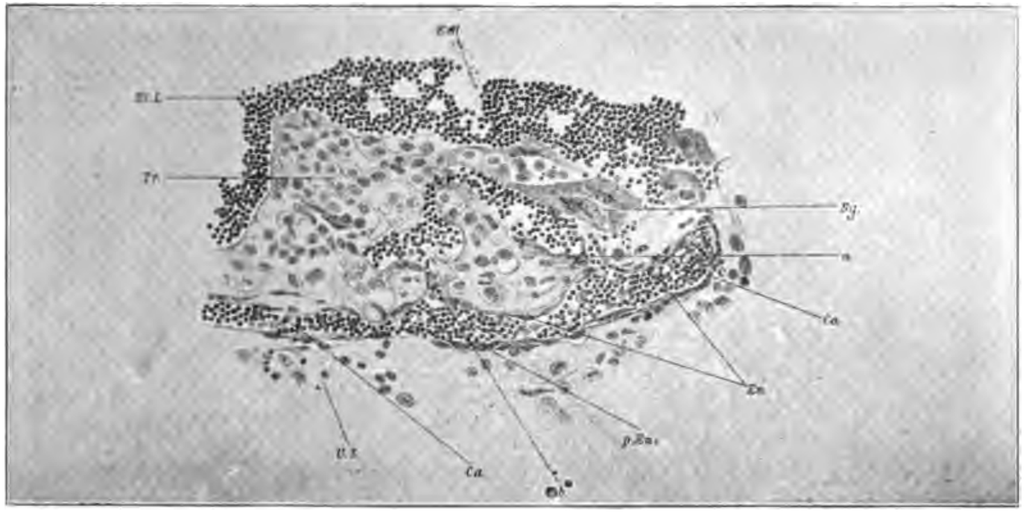

FIG. 6.—Section of a portion of peripheral trophoblast in close relationship with the wall of a dilated maternal capillary. First week of pregnancy. *Tr*, trophoblast; *BlL*, lacuna in trophoblast containing maternal blood; *Sy*, syncytium; *UZ* maternal connective tissue; *Cu*, enlarged maternal capillary; *En*, endothelium of capillary; *a*, *b*, *c*, communications between capillary and trophoblastic lacunæ.—(H. PETERS.)

In Leopold's fifteen-day specimen the serotina measured 2-3 mm. in thickness. The compacta was filled with abundant dilated capillaries, just as was the lower portion of the reflexa. The outer ends of the glands appeared mostly as narrow slits. In the deeper part of the mucosa the gland spaces were irregular, the desquamated epithelium lying mainly in masses in the lumina. A few glands had preserved their sinuous outline. Most were represented by irregular slits. Small extravasations of blood were noted in the decidual tissue.

Schwabe has described a 13-15-day abortion. The serotina was very similar to that in Merttens' case. He noted the large blood-spaces in the compact layer. On the surface he also noticed a layer of nucleated protoplasm heaped up in masses at intervals. Projections of the epiblastic covering of some of the villi were seen to extend into the decidua. In E. Fraenkel's 3½-week abortion the conditions found were much the same. The large decidual cells were almost entirely limited to the compact layer. The surface part showed the fibrin streak. Blood sinuses were seen to communicate with the intervillous space.

In Kupffer's 3-4 week specimen the same conditions were noticed. Sinuses were seen to open into the intervillous space. The epithelium in the glands was more altered than in those of the vera.

In Minot's one month specimen, the compact layer measured about one quarter of the thickness of the serotina. He noticed the branching of the large decidual cells. There was no special formation around vessels. Toward the spongy layer the cells were smaller. In the compact layer the glandular epithelium had been largely cast from the walls. The gland-spaces of the spongy layer were enlarged and distorted. In the smaller spaces the epithelium was columnar and fairly well preserved. In the larger ones the epithelium was somewhat broken up and thrown into the lumen; in many cases considerably degenerated.

AT THE SIXTH WEEK.

The serotina is about 2-3 mm. in thickness, the compact layer measuring 1/5 to 1/4 of the whole. While in general the distinc-

tion between compact and spongy portions is easily made out, in a few places, where the glands are scanty, the whole serotina might be described as compact. Variations in the structure of the mucosa occur in the non-pregnant normal uterus, and it is therefore not surprising to find them in any pregnant uterus.

Surface Epithelium.—No remains of the surface epithelium can be found. The views of certain authors, *e. g.*, Merttens and Kossmann, that it is changed to a plasmodial structure cannot be sustained. I shall refer to this later.

Glands.—The outer parts of the glands in the compact layer are largely obliterated. The epithelium in them is found in different conditions. In a few glands it is still columnar and attached. In most it is cubical or irregular and the cells are somewhat loosened; or in certain parts they are fused together, their inner surfaces being ragged and irregular. The nuclei are round or irregular. In many cases the cells are lying in the lumen, more or less degenerated. In the spongy layer similar changes are found in the glandular epithelium. Near the muscle some gland-ends exist with fairly-well preserved columnar cells.

The surface of the serotina is irregular, showing small elevations and depressions. No papillæ of any size are seen.

Interglandular Tissue.—The decidual tissue varies considerably. In parts are found masses of the characteristic, well-defined decidual cells with oval or rounded nuclei. In several places degeneration can be seen, the cells being somewhat swollen or fused into a faintly staining mass in which vacuolation is found, the nuclei being irregular in outline. Here and there the latter may, to a considerable extent, have lost their surrounding cell-substance. The superficial part of the compact layer is occupied by an irregular layer of fibrinous material, broken at intervals. In it may be found shrunken and degenerating cells. It stains very deeply with eosine. Here and there processes from it extend inward, showing transitions from faintly to deeply stained parts. It is very likely that the former is the earliest stage in the process of degeneration. These appearances may be found around several blood sinuses.

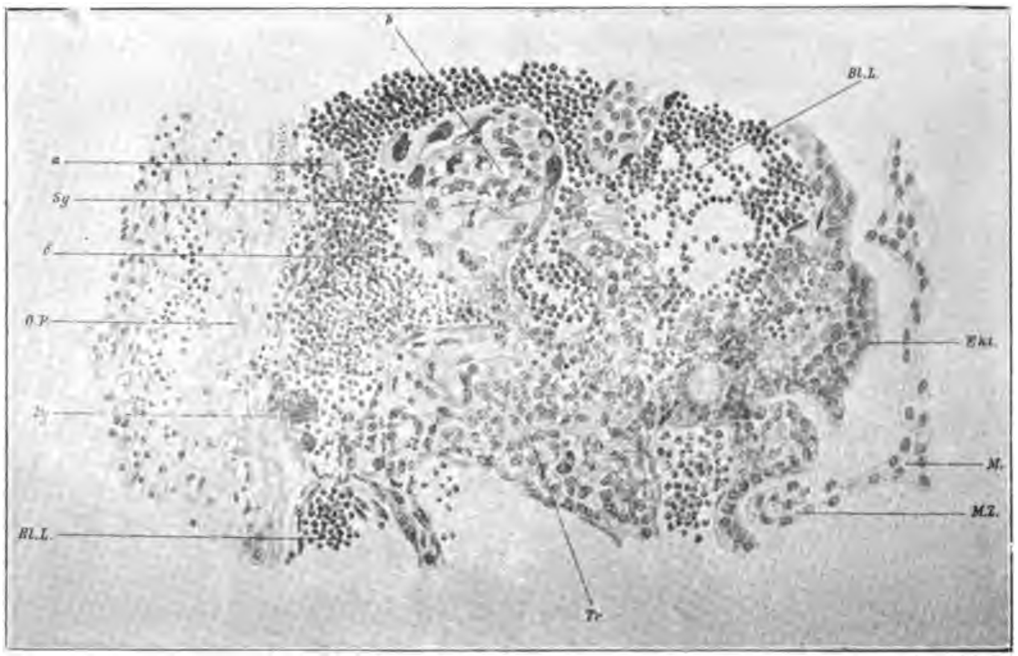

FIG. 7.—Section through wall of ovum and through blood-clot lying against it between edges of decidua reflexa. First week of pregnancy. *M*, chorionic mesoblastic layer; *MZ*, mesoblast extending out to form core of a future villus; *Ekt*, chorionic epiblast; *Tr.* trophoblastic extension of epiblast; *BlL*, lacuna in trophoblast filled with maternal blood; *Sy.* syncytium; *G P*, blood-clot lying against outer polar portion of ovum; *a. c*, degenerated blood in relation to syncytium. —(H. PETERS.)

This must be distinguished from fibrin masses on the surface or in the decidua resulting from blood coagulation. In the latter, often red corpuscles may be seen.

Scattered between the degenerating decidual tissues are masses of cells quite distinct from the pale areas of degenerating decidual cells. They are found in various sizes and shapes, mostly in strands. The matrix and nuclei stain deeply. These masses may also be found here and there in the outer part of the spongy layer. The decidual cells, on careful examination, are found to anastomose with the surrounding degenerating cells. They are probably active and growing and have not begun to degenerate.

It is interesting to note that in the vera no such appearance is found save close to the serotina. There the degeneration is of a different nature, more diffuse and slower.

On the surface no uterine epithelium exists. At intervals the villi are attached.

Syncytium.—Between the villi are attached somewhat flattened masses of nucleated protoplasm—plasmodium or syncytium. It appears to be a much less uniform and more broken layer than in Merttens' early specimen. No distinction into cells can be made out. The protoplasm is finely granular and takes on a deep stain. The nuclei are irregularly rounded and also stain deeply. Some of these masses have only a single row of nuclei, others have several. In others the nuclei are irregularly distributed. At intervals the masses are thickened, resembling very large multinucleated giant cells. Here and there prolongations extend out for short distances into the intervillous space. In a few places this plasmodial tissue has a reticular structure, consisting of irregular spaces and trabeculæ.

Some of the stalks extending outward are attached to the ends of the villi near the surface. and the outer epiblastic covering of those villi which are joined to the decidua is continuous with adjacent masses lying on the surface of the serotina. Their identity is as evident as their continuity, and has been recognized by several observers, though there is a difference of opinion as to the origin and significance of the syncytium.

Merttens and Kossmann have recently directed considerable attention to it. They believe that its origin is the epithelium of the surface of the mucosa and uterine glands. I have pointed out the existence of the syncytium on the decidual surface in tubal pregnancy, and have stated why I believed it to be the remains of the outer epiblastic layer of the early blastocyst, probably trophoblastic in nature, leading to the absorption of different elements of the maternal tissues.

It is very important to observe that *the vera at the sixth week shows not a trace of syncytium, when the latter is abundantly present on the serotina.* Indeed, at this period, as I have shown, large portions of the vera are covered with the original cells, somewhat flattened, certainly, and varying in shape, but showing no trace whatever of a transformation into syncytium.

Of great interest are the processes of this material which are found extending into the substance of the decidua. These are found in irregular strands and masses of various sizes, quite distinct from surrounding decidual tissue. They extend inward mainly obliquely. It is probably owing to this arrangement that so many detached pieces are found in microscopic sections, the strands not being divided in their continuity. Separate pieces may be found in the spongy layer or even in the muscular layer; it is difficult to say whether these work their own way, or are carried in lymph or blood streams. Near the surface, strands may sometimes be seen extending into the blood sinuses, to whose walls they may become attached. Some vessels may be found almost or completely filled by them.

I have pointed out that Merttens has also recently described these appearances in his earliest specimen. But he has also wrongly supposed them to be the product of the original mucosal epithelium.

Blood-Vessels.—A few small capillaries may be seen in the compact layer. For the most part only large sinuses exist. Here and there one may be noticed opening into the intervillous space. In most cases the endothelium is well preserved. In some, masses of syncytium which have penetrated them are attached to the wall. Very rarely does a villus dip into the mouth of a sinus, where it may

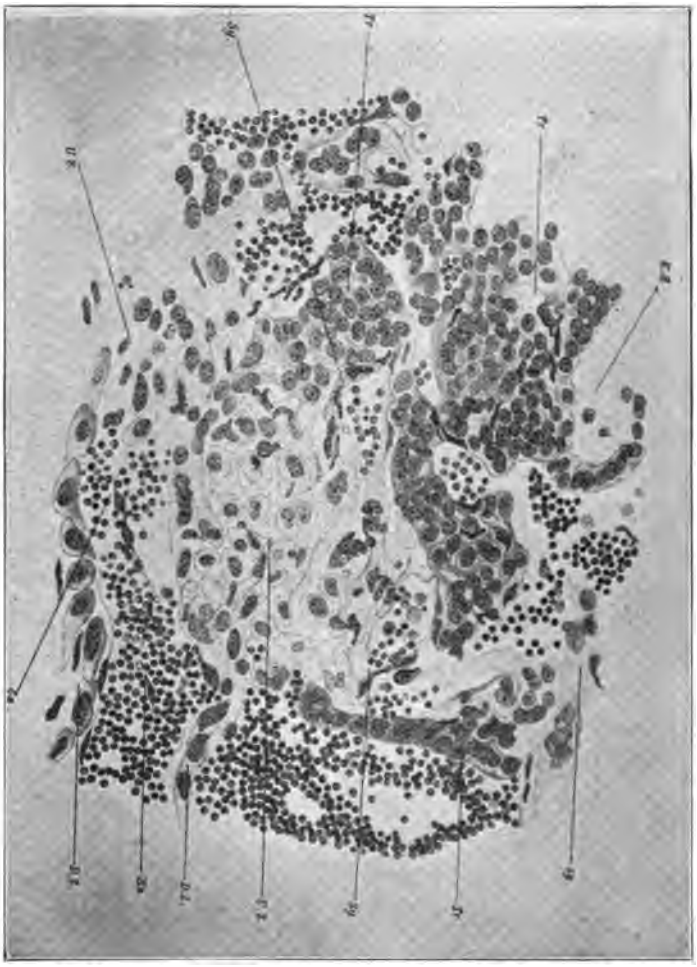

FIG. 8.—Section through junction of trophoblast and maternal tissue, First week of pregnancy. *Tr*, irregular mass of trophoblast; *Sy*, syncytium; *U Z*, maternal tissue; *D Z*, early decidual cells; *Ca*, dilated maternal capillary; *En*, endothelial layer separated from wall of capillary. -(H. PETERS.)

hang free or be attached to the wall. I can make out no distinction between arteries and veins in the compact layer. The sinuses are practically dilated capillaries, and according to the flow of the stream of blood the openings into the intervillous space may be called afferent and efferent. In the spongy layer the small arteries run tortuously outward. In several is found endarteritis. Here and there is seen a thickening or condensation of the surrounding decidual tissue.

AT THE FOURTH MONTH.

The serotina is somewhat more irregular on its inner surface, so that its thickness varies more than at earlier periods. Thus, different measurements are found, *e. g.*, from 1 to 2.5 mm. Here and there small hillocks of decidua extend from the surface measuring in height from 0.5 to 1.5 mm. Occasionally they may be found longer. These hillocks are very irregularly distributed. Over considerable portions none exist.

On the average the serotina is thinner than it was during the second month, the reduction having taken place both in the compact and spongy layers. In the compact layer a few small gland-spaces are seen, considerably compressed. Very few cells are attached to their walls. In the spongy layer the gland-spaces are greatly compressed and are lying largely parallel to the surface. They are almost entirely empty of epithelium. What does exist is in a state of degeneration. Close to the muscle a small space may be found, here and there, lined by a layer of cubical cells.

The fibrinous degeneration in the decidual tissue has advanced considerably. It is mainly in the superficial layers, but extensions downward are found. The oldest portions are dense and structureless, containing shrunken and broken-down nuclei. Vacuolation is marked in parts. The staining with eosine is deep. In many parts fairly normal cells are found. Near the surface these are arranged parallel to it. Here and there the cells are fused together, vacuoles being present in the matrix or in the nuclei. Other cells are irregular in outline. These various conditions, except the advanced fibrinous degeneration, are found also in the spongy layer.

Masses of syncytium are scattered irregularly through the whole decidua, being also found in adjacent parts of the muscular layer. They lie in spaces in the connective tissue, but are also found in several vessels. On the surface of the decidua, masses are lying with outward and inward prolongations, just as in the six-weeks specimen. The villi are generally more firmly attached to the surface, their ends being imbedded in varying degrees, whereas in earlier specimens they are mostly found on a level with it. Blood-sinuses are relatively not so numerous in the decidua as at an earlier period. Numerous undilated capillaries are seen. The walls of several vessels are surrounded with thick fibrin, as a result of which the lumen has been considerably contracted. Also, in several, endothelial proliferation is found; this change may also be found in vessels in the muscular part of the uterine wall.

On the surface sinuses may be found, communicating with the intervillous space. Rarely does a villus extend into the opening. Very few vessels in the well-marked decidual elevations communicate with the intervillous space, and they are, like the other thin-walled sinuses, formed from dilated capillaries. I can make out in them no special structure characteristic of artery or vein.

AT THE SIXTH MONTH.

The decidua varies in thickness, variations being found in both the compact and spongy layers. The surface is irregular, but most of the elevations are not so prominent as at earlier periods of pregnancy. Occasionally a hillock rises to the height of 1 or 2 mm. Very few traces of glands remain in the compact layer; they are in the form of a narrow canal filled with debris, or of a single or double row of cubical cells compressed by decidual tissue.

The spaces in the spongy layer are considerably elongated, lying parallel to the surface, largely free of lining epithelium or even of degenerated remains in the lumen. In the deepest portions of some a lining of cubical cells exists.

In the compact layer the fibrinous degeneration is more marked than it was at the fourth month. It is still mainly near the surface, but is also found in scattered masses deeper down.

Very slight traces are found in the spongy layer. The decidual cells, which are not affected vary in appearance. They appear as irregular groups of rounded cells or as masses of spindle-cells, closely packed and arranged parallel to the surface. In some parts the loose reticular arrangement is well seen. Here and there vacuolation is found in nuclei or cell-matrices. On the whole cells nearest the surface are largest and most densely stained. In the outer parts of the spongy layer well-marked decidual cells exist. They extend downward for varying distances.

Masses of syncytium are found throughout the decidua, but not at all as abundantly as at the fourth month. It is also seen in strips or in masses on the surface, but relatively less of the surface is covered by these masses and they are, on the average, thinner than at earlier periods.

The blood sinuses, on the whole, are not so large as in the early months, and they are less crowded, though their distribution varies in different parts. Several are considerably diminished by the apparent fibrinous changes in or around the wall. Marked thickening of the intima is noticed in some of the smaller vessels leading to the sinuses. In several the lumen is nearly closed. These changes are also found in some of the vessels in the spongy layer and in several in the muscle.

AT FULL TIME.

The serotina varies greatly in structure at different parts. In some places it is almost absent, only the thinnest layer of decidua intervening between the muscular layer and the villi. In a few parts it is entirely wanting, the villi being next the muscle. These parts must have been thin at the commencement, and their disappearance is due to mechanical stretching and to physiological absorption.

Over a large extent its thickness only measures from 0.5 to 1 mm. Here and there hillocks both narrow and broad project from the surface. The compact and spongy layers have been thinned differently in different places. The trabeculæ of the latter are very narrow. Some appear to have been torn across or absorbed.

FIG. 9.—Another of the same. *Tr*, trophoblast; *Sy*, syncytium; *UZ*, maternal tissue; *G*, line of demarcation between trophoblast and maternal tissue; *Dr*, maternal gland; *Bl*, blood in gland-lumen.—(H. PETERS.)

In the compact layer very few traces of glands exist; their epithelium is entirely absent. In the spongy layer the elongated narrow spaces are arranged mostly parallel to the muscle. In most there is no debris of epithelium. Only very few close-to or between muscle-bundles have a lining, partial or complete, of cubical epithelium. These are flattened parallel to the surface.

The decidual tissue presents varied appearances. The superficial portions of the compact layer are largely changed into the fibrinous material, which stains very deeply. Some parts of this are dense, being striated. Others are of a looser texture, vacuolation being present in it. Imbedded in it are nuclei in various stages of degeneration. Immediately under this is an irregular area of less deeply-staining fibrinous tissue in which cell-outlines and nuclei may be distinguished. Also masses of decidual cells are found with a swollen appearance and staining lightly. In many the cell substance or the nucleus is vacuolated. In other parts well-formed large decidual cells are seen, those nearest the surface lying more or less parallel to it. It is noticeable that they take on the stains with varying intensity in different parts. Here and there masses of well-marked branching and anastomosing cells are found, the cells having one or two nuclei.

Leucocytes are not numerous anywhere, least of all where the fibrinous material predominates. In the trabeculæ of the spongy layer, the cells are not of very large size, the largest being in the outer portions. Some show marks of degeneration. Scattered in the decidua and neighboring muscle are found irregular masses of syncytium, varying in size and shape. In some places the decidua surrounding a large mass gives one the impression of gradually being absorbed by the syncytium.

On the surface masses and strips are found, but they are more flattened and shrunken. They cover relatively much less of the surface than in the early months.

The sinuses vary considerably in distribution and appearance, as was the case at the sixth month. The same changes then noted exist, viz.: the contraction of many by fibrinous thickening around

them, the partial or complete closure of some of the small vessels in the decidual and muscular wall, due to thickening of the intima.

Here and there blood-extravasation is found in the decidua. It may be found both among the cells and in the gland-spaces.

NATURE OF THE PROGRESSIVE CHANGES IN THE DECIDUA.

It has been pointed out that the decidua reaches its highest point in development at an early period, viz.: some time during the second and third months. At the end of pregnancy it is evident that diminution in thickness has taken place. This is partly due, it seems to me, to the pressure of the uterine contents as well as to the gradual stretching which takes place in a direction parallel to the surface. In support of these statements is the arrangement of the gland-spaces parallel to the surface as pregnancy advances, the thinning of the trabeculæ of the spongy layer and the tearing across of many of them in the late months. The general tendency in the individual cells of the decidua to lie more or less parallel with the surface should also be mentioned. The loosening of different bundles of cells in the different parts of the compact layer may also be due to the stretching, though it may be partly due to a tendency to return to the pre-existing mucoid type of the interglandular tissue. To the stretching may be partly due the casting-off of the cells lining the glands.

CHANGES NON-MECHANICAL IN NATURE.

The degeneration and disappearance of the epithelium on the surface and of that lining the glands is now beyond dispute. The contention of Kossmann, Merttens and others, that it forms plasmodial masses which burrow into the decidua and extend over the villi, is utterly untenable.

The degeneration may be partly mechanical, *i. e.*, the cells may become flattened and separated as a result of the rapid increase in the interglandular tissue from formation of decidual cells, but it may also be due to the choking of the lymphatics by this increase,

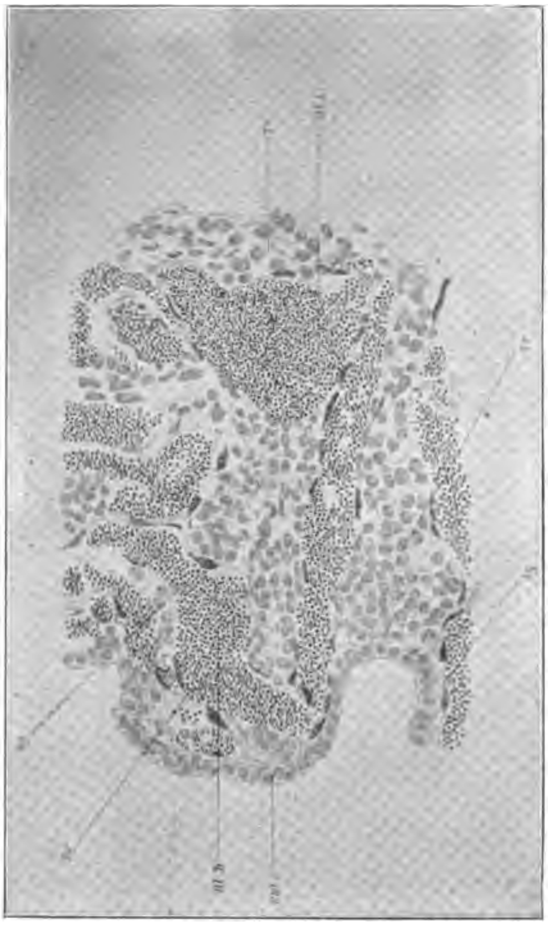

FIG. 10.—Section through the chorionic epiblastic layer and part of the trophoblast. First week of pregnancy. *Ekt*, chorionic epiblast; *Tr*, trophoblast; *Sy*, syncytium; *Bl L*, lacunæ containing maternal blood.—(PETERS.)

and the consequent interference with the nutrition of the epithelium covering the decidua and lining those parts of the glands in the compact layer. The latter always degenerate before those in the spongy layer. Perhaps the epithelium in the deepest parts of the glands is mainly affected by the mechanical stretching.

As to the degeneration in the interglandular tissue there can be no doubt that the most marked change is the coagulation-necrosis, which gives rise to the progressive so-called hyaline or fibrinous transformation. These layers of fibrin in the serotina were first described by Nitabuch, who demonstrated the frequency of a layer in the superficial part of the serotina, believing it to be derived from fetal epithelium. As I have shown, this change may be found as early as the sixth week, and in the reflexa at an earlier period. It occurs chiefly in the superficial layer, though it extends here and there within the substance of the decidua. The supposition of Nitabuch and Langhans that it always marks the outer limit of the decidua cannot be held as strictly accurate, because occasionally the fibrin is separated from the surface by a strip of unaltered decidua. In general, however, the fibrin is the surface boundary, where it does exist, being in relation with the fetal syncytium or with the villi.

I have pointed out the gradual extension of the fibrinous change with the advance of pregnancy and its occurrence in the walls of vessels. It is of great interest to note that this marked degeneration does not take place in the vera, but only in the serotina and reflexa. Though undoubtedly after the early weeks changes are found in the vera of a degenerative nature, the masses of deeply-stained fibrin are not found. The explanation of this is not quite evident.

The first suggestion that occurs to one is that it must be related to some condition which is from an early period common to serotina and reflexa, but not to the vera, *i. e.,* the direct relationship to fetal structures. It is possible that the degeneration is marked because of some influence of the fetal epiblast. Hart and Gulland have pointed out that the decidua near the ends of the attached villi appear to be more degenerated than that farther away.

Young and active villi do not come into contact with the vera because by the time the reflexa is absorbed and the chorion læve and vera come together, they are largely degenerated and useless. At that time also, the influence exerted by the rest of the chorion læve must be different from that which exists in a younger and more active condition of the villi.

Another possibility must be considered, viz., that the fibrin layer is in some way related to the blood in the intervillous space which bathes the surface of the decidua.

Steffeck has pointed out that part of the surface layer of fibrin may be formed from the blood. I have also noted this in cases of tubal gestation. I have found fibrin in the serotina in various stages of formation, containing, however, usually blood-corpuscles in its meshes, continuous with a subjacent layer of fibrin formed from necrosed decidual tissue. I have also pointed out that some of the fibrin-masses in the substance of the decidua were the result of blood-extravasations.

Another possible cause of the degeneration is the following: The compact layer is the seat of the earliest and most rapid growth of decidual cells. As a result of this growth, there is compression and obliteration of many of the lymph-spaces as well as the capillaries which do not dilate to form large sinuses. In this way the nourishment of the superficial layers of the decidua is undoubtedly interfered with. This condition is probably aggravated by the pressure of the uterine contents against the decidua. In the spongy layer, owing to the presence of numerous spaces, there is no danger of interference, with the cells' nutrition.

It is possible, also, that the early rapid formation of large blood-sinuses in the compact layer may increase the pressure on surrounding cells.

IS THERE ANY FATTY DEGENERATION?

I have described a condition of vacuolation in nuclei or in cell-matrices. The appearance is one which might easily be mistaken for fatty degeneration, but special staining reactions prove that it is

not this. Gustav Klein, who has worked carefully at this point, holds that fatty changes are very rarely found in normal conditions, but not *infrequently* in pathological states. The old and long-taught view that the chief degeneration of the decidua is of a fatty nature cannot be held.

ABSORPTION OF DECIDUA.

Absorption and gradual disappearance of some parts of the decidua, especially of the degenerated parts, takes place in all probability throughout pregnancy. The absorption may take place directly into the maternal circulation or by the agency of leucocytes. But there can be little doubt that it is also brought about by the agency of the fetal epiblast, *i. e.,* by the original layer of the blastocyst which is applied early to the decidua, and which is met with throughout pregnancy as the irregular masses of syncytium attached to the surface, as well as those which extend into the substance of the decidua; also through the same material on the ends of the villi attached to the maternal tissues. This suggestion has also been brought forward by me in my work on "Ectopic Pregnancy." The trophoblastic nature of the outer epiblastic layers of the ovum, which Hubrecht so clearly showed in the case of the hedgehog, must be considered well-established. It has also been demonstrated in the case of other animals.

But degeneration is not the only change which is met with in the decidua during pregnancy. Were it not that *pari passu,* some new formation of tissue goes on, it seems to me certain, that, as a result of the enormous increase in the area of the uterine wall from the time when the decidua reaches its highest development (viz.: between the second and third months), the stretching and degeneration and absorption of the decidua would lead to its entire disappearance before the end of pregnancy. Indeed, I have shown that at full time, the serotina, in certain parts, has nearly or entirely disappeared by full time; probably at these points the decidua was thin in the beginning, its constituent cells being not sufficiently active to oppose the destructive agencies.

In my description of the minute changes at different periods I have pointed out the presence in the decidua of irregularly-distributed groups of cells which were evidently more active than surrounding cells. Gustav Klein has made the same observation, and to these he has given the name of *"Ersatz-zellen,"* believing that they are mainly instrumental in the reformation of the mucosal cellular tissues *post partum*. They may share in this process, but I am inclined to regard them as mainly instrumental in renewing to a certain extent the wear and tear in the decidua during pregnancy. It is necessary that there be this renewal to explain the considerable amount of decidua found at full time.

I have also pointed out the tendency in large cells in certain parts of the decidua, during the late months, to become gradually smaller and to form a looser arrangement of anastomosing cells, very like the embryonic inter-glandular tissue of the non-pregnant state. The chief difference is in the larger size of the nucleus and in the stronger staining reaction of the matrix. It is possible, as I have before stated, that in some parts the looser arrangement of cells may be caused by the stretching which the decidua undergoes.

CHAPTER V.

THE EARLY RELATIONS BETWEEN THE OVUM AND DECIDUA.

Until the publication of Peters' work, all statements regarding the early relationships of ovum and decidua were speculative. His sections have added much to our knowledge, and must be noticed in detail.

The chorionic vesicle in his specimen was a lenticular mass measuring 3, 1.5, 1.5 mm. in its three diameters, the longest being parallel with the serotina. This is the smallest yet described.

It was imbedded in the outer part of the compacta, save at its outer polar part, where there was an area, 1 mm. in diameter, covered only by blood-clot, which closed the gap in that portion of the decidua under which the ovum had excavated, and which represented the earliest stage of the reflexa. No remains of the maternal epithelium were found under the ovum. All around the vesicle was a marked development of epiblast—the trophoblast, thicker next the serotina than on the outer surface of the ovum. It was not solid, but consisted of irregular processes, between which were lacunæ of various sizes, many of which were filled with maternal blood. Toward their outer ends some of the processes divided irregularly. A thin layer of fetal mesoblast lay internal to the trophoblast, into slight depressions of which extensions passed for a short distance. The layer of trophoblast external to the mesoblast varied in thickness from one to several layers of cells. The inner cells were mostly cubical, the nuclei being large, round or oval, and finely granular, staining deeply. Where the blood filled a lacuna lined by one layer of cells next the ovum, the latter tended to be somewhat flat or irregular. Some of the cells stained lightly and were vacuolated. Some nuclei were broken up, others vacuo-

lated or containing dark particles, occasionally the nuclear membrane being crumpled. These changes were mostly found away from the ovum. Mitoses were not noted, though nuclear division into two or more parts was often found, indicating some proliferating of the trophoblast cells. In the outermost parts, cells showed more irregularity of outline and degeneration. Vacuolation of the trophoblast was here well-marked. The blood-lacunæ were largely lined by a nucleated protoplasm in which no cell-outlines could be distinguished.

This was regarded by Peters as the earliest form of the syncytium. It was derived from the trophoblast next the maternal blood, the fusion of cells being brought about partly by the pressure of the blood and by the action of the blood-plasma on the cells. Broken-down blood-corpuscles seemed also to enter into its formation.

In different places, trophoblastic processes penetrated maternal blood-sinuses in the decidua. Next the ovum, the thinning of the trophoblast was regarded by Peters as due to the increase of maternal blood in the intervillous spaces on the one side, and on the other, to the increase of the fetal mesoblast.

In Leopold's earliest specimen the area of the decidua in which the ovum lay measured 6 mm. in length by 4 to 6.5 mm. in height. The chorionic vesicle measured 4 mm. in height and 3.7 mm. in width. It was covered with villi, save for a small area at its outer polar portion.

The ovum presented two concentric zones. The internal had no distinct structure—a sort of coagulated albumen. The external was clear, the outer part being very distinct, the chorion. From it villi extended outward. The space external to the ovum was largely filled by branches of villi. They were made up of a delicate mesoblastic tissue core and a covering epithelium like that on the wall of the vesicle. In some capillary formation was in progress. Villi were attached both to serotina and lower area of reflexa. In one or two places their ends entered depressions in the mucosa—which might easily have been mistaken for gland openings. At one

part an elevation of the serotina reached near to the chorion, having on its surface a thin layer of fibrin to which the fetal epithelium adhered.

In one part, lying among villi, were a couple of small pieces of decidua, to one of which villi were attached. Leopold considered these as sections of decidual septa.

The villi consisted of a few large trunks or stems and numerous small branch-villi. The earliest villi were little buds of chorionic epithelium of a syncytial character; into these the mesoblast afterward extends. Giant cell masses lay along the villi and on the serotina. Maternal blood lay between the villi. Some of the villi which reached the decidua merely touched it; others were adherent and others slightly imbedded. An irregular syncytial layer was attached to the surface of the serotina.

In Merttens' early specimen, obtained from a curetting, supposed to be from six to eight days old, the chorionic vesicle was imbedded in the serotina and reflexa, the diameter of the vesicle being about 3 by 2 mm. Its outer surface was covered with villi measuring .5 mm. and less in length; they were simple or only slightly branched. Most of the villi were at right angles to the chorion; some were oblique. Many were attached to the decidua serotina. They were composed of a covering of epithelium containing a core of connective tissue. The epithelium consisted of an inner layer, Langhans' *Zellschicht,* and an outer one of deeply staining nucleated plasmodial protoplasm, *syncytium.* On the surface of the reflexa and the serotina was found an irregular layer of syncytium, continuous with the outer epithelial layer of the villi. In the intervillous space maternal blood was found; decidual sinuses had therefore already opened into it.

In Reichert's thirteen- to fourteen-day specimen the chorionic vesicle was lens-shaped, measuring 5.5 mm. in the long diameter and 3.3 in the short one. There was an equatorial zone of villi, the polar regions being smoth; one was smaller than the other. The small one was in relation to the serotina. The villi varied somewhat in size. They averaged about .2 mm. in length, were thick

and rounded at the ends and mainly unbranched. Reichert said that they consisted entirely of fetal epithelium, and contained no connective tissue core. Most of them were hollow. (It is unfortunate that Reichert's specimen was not carefully hardened and examined microscopically. We can not now form a complete idea as to the conditions present.)

In Breus' twelve- to fourteen-day specimen the chorionic vesicle was somewhat round, measuring about 5 mm. in diameter, including the villi. The latter measured from .07 to 1 mm. in length. They

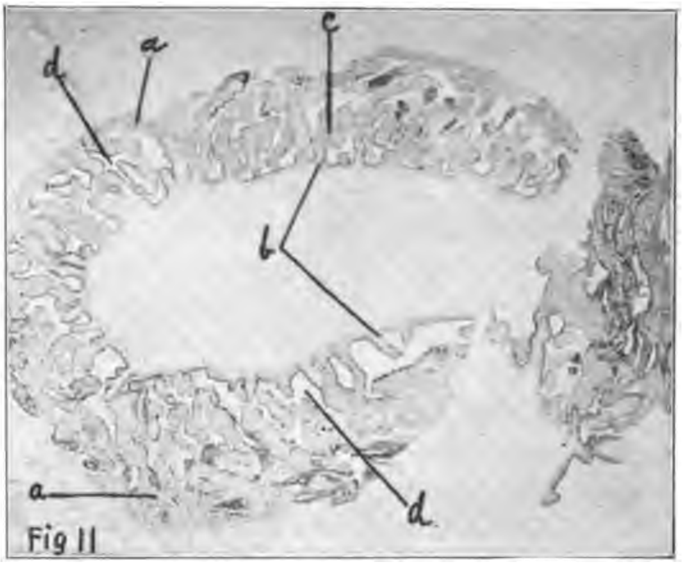

Fig. 11.—Mertten's drawing, illustrating the relationships of the ovum in the early specimen described by him. *a*, **decidua;** *b*, **chorion:** *c*, **villi of chorion;** *d*, **intervillous space.**

were thick and mostly unbranched. In one spot there were no villi. The villi were largely epithelial in nature, though some contained a core of connective tissue.

In Schwabe's thirteen- to fifteen-day specimen, the plasmodial nature of the outer epiblastic covering of the chorion and villi was noted. He also described extensions of plasmodium on the surface of the decidua.

In Spee's second-week specimen, the same thing was noticed.

Some of the villi consisted entirely of epiblast, and were attached to the decidua. Others contained connective tissue.

In Kuppfer's three- to four-week specimen, though villi were found over the whole chorion, they were most strongly developed in an equatorial band. The covering epithelial layer consisted of an outer and an inner part. The outer layer of syncytium was of the same nature as that on the decidua. Processes extended into the latter, and in two places were seen to penetrate sinuses.

In Keibel's supposed thirteen- to fourteen-day specimen the continuity and identity of the syncytial layer on the decidua and the outer covering of the villi was easily recognized.

In Kossmann's two- to three-week specimen the same points were made out.

Other early specimens have been described, but they need not be particularly noticed.

From a careful study of the whole series, it is evident that either the exact duration of pregnancy has not always been correctly estimated or that the early ovum is subject to considerable variations in regard to its rate of growth, its shape, the appearance and rapidity of development of the villi. For example, in Reichert's supposed twelve- to thirteen-day specimen, the chorionic vesicle had two smooth surfaces devoid of villi. In Merttens' supposed six- to eight-day case, the whole vesicle was covered with villi. In Leopold's of the same period, the outer polar portion was devoid of villi. In Breus' specimen, supposed to be about the same age as Reichert's, only one spot was devoid of villi. In the specimens of a more advanced age than Reichert's, either the whole vesicle was covered or one spot was bare.

In fact, in the various descriptions there is such a lack of uniformity that exact comparisons can not be instituted. A great omission in most of them is a careful account of the fetal epiblast and its relations to the decidua.

As far as our knowledge goes, we may be justified in making the following statements regarding the relationship of the early ovum to the decidua in the human female.

1. In the earliest pregnancy yet described, the chorionic vesicle is imbedded in the substance of the compact layer of the uterine mucosa, having apparently eaten its way, probably by the activity of the epiblastic covering.

2. In this specimen the epiblast forms a thick layer of trophoblast which is broken up by vacuoles and spaces, many of which contain maternal blood. The strands between the blood-spaces consist of nucleated cells distinct from one another. Transformation of some of these into syncytium is beginning, especially where they are in contact with maternal blood.

3. During the second week the fetal mesoblast, in which capillaries develop, penetrates the trophoblastic strands—which may be considered as the primary villi. Many of these are attached to the serotina and reflexa, remaining in connection with the former as permanent villus-stems. New villi are also in process of development, the earliest forms being buds of fetal epiblast.

4. During the second week, when an intervillous space is well established and many villi are composed of epiblastic and mesoblastic tissue, there is found on the decidual surface an irregular layer of syncytium or plasmodial nucleated protoplasm, identical with that found on the outer part of the fetal epiblast, in many places where villi are attached being directly continuous with it. Irregularly shaped masses of this syncytium project from the decidual surface into the intervillous space, some of which have a reticular structure. Processes also extend downward into the mucosa among the decidual cells.

In my investigations of specimens of early tubal pregnancy ("Ectopic Pregnancy," 1895) and of uterine gestation (*American Gyn. and Obstet. Jour.,* 1897) I referred to the important researches of Hubrecht in the Insectivora (whose work until that time had received scant notice), and showed that the conditions found in the human female pointed strikingly to the occurrence of changes in the early stages of implantation of the ovum similar to those described in the hedgehog by Hubrecht. This author had pre-

viously stated that workers in human embryology would probably establish a close resemblance.

He had shown that when the early ovum of the hedgehog was attached to the decidua, a proliferation of the epiblast took place, forming a plasmodial layer of considerable thickness. Vacuolation occurred at different points in it, whereby a reticulated structure was produced, which thereupon formed the connection between ovum and decidua. That part of the epiblast which was in contact with the decidua was termed by him the *trophoblast,* a term which has since been widely adopted.

In a more recently published paper on the trophoblast and amnion, Hubrecht, from a comparison of the results obtained by himself and others in the investigation of the early ovum in different mammals, comes to the following conclusions:

1. The outermost part of the covering of the blastocyst takes no direct part in the formation of the embryo.

2. This layer, the so-called trophoblast, serves in the first place in the fixation of the ovum to the maternal tissues, and then, by the marked proliferation which takes place in it, at a certain part or in its whole extent, in obtaining nutriment for the ovum.

3. The formative epiblast of the early embryo in the germinal area is, from the first, under cover of the trophoblast, the relations between the two layers varying somewhat in different mammals.

In my "Ectopic Pregnancy" I referred to Hubrecht's work as follows:

"So, too, it is probable that in the human ovum—whether from the whole blastocyst or parts of it is not certain, although from the early ova described, possibly only part may undergo the change—the outer epiblastic layer, on entering into relationship with the decidua gets to consist of a thick nucleated protoplasmic mass which attaches itself to the decidua, to the serotina, and also to the reflexa. As growth goes on vacuolation appears in the mass, so that the ovum becomes connected to the decidua by a reticulated, nucleated, protoplasmic structure."

I was wrong in believing that the early epiblastic proliferation

would be shown to be syncytial in nature, but in other respects the predictions made by Hubrecht and myself have been justified by the magnificent work of Peters.

The condition in Peters' specimen differs in one important particular from that in the hedgehog, viz., the mode of implantation. Hubrecht showed that the ovum rested in a depression in the surface of the mucosa and that the edges grew up around it. In other respects the phenomena were identical, viz., phagocytic action of the epiblast, increase of the latter, forming trophoblast, reticulation of the latter, congestion of maternal capillaries, edema, formation of blood-clot between the edges of the reflexa, etc.

With regard to the explanation of the existence of the layer of fetal syncytium on the decidual surface in early human gestation, it seemed to me that it must be derived from the outermost portions of the trophoblast, being pressed against the decidua as the blood increased in the intervillous spaces.

There was another possible interpretation, viz., that when the smooth blastocyst comes into contact with the decidua, outgrowths of epiblast occur, which, on reaching the decidua, extend over its surface, forming an irregular layer, from which prolongations extend afterward into the decidual substance. This account, however, did not seem to me so feasible as the other, and offered no rational explanation for the formation of the reticulated masses or of the irregular projections from the epiblast on the surface of the decidua; whereas, their description as remnants from the early reticulated connection between ovum and decidua is thoroughly intelligible.

It is certain, moreover, that in the process of attachment of the great mass of villi, which leads to the establishment of the permament placenta, the plasmodial outer layer of the villi becomes broken up, as the deep cells of the epiblast in the ends of the villi proliferate to form a large, adhesive surface.

As I have pointed out, in specimens of ectopic gestation only a few villi are to be found attached by stalks of the outer plasmodial epiblast layer, and these I regard as having arisen from the exten-

sion of the mesoblastic elements of the chorion into strands of epiblast, the remains of the reticulum extending from decidua to ovum. As regards the probable functions of the early epiblastic proliferation, I would suggest the following:

1. It seems to fix the ovum to the mucosa. It is generally supposed that the earliest fixation takes placed by means of villous projection of the *zona pellucida*. In the human subject, however,

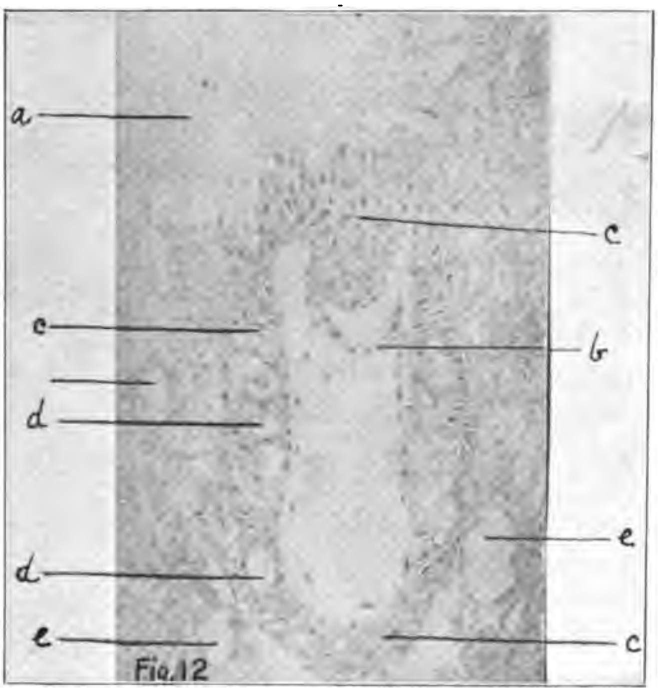

FIG. 12.—Hubrecht's diagram, representing the early relationships of the embedded ovum in the hedgehog. *a*, uterine mucosa; *b*, hypoblast of ovum; *c*, proliferation of epiblast of ovum - trophoblast; *d*, lacuna in the trophoblast, into which maternal blood afterward finds its way; *e*, dilated vessels of the mucosa.

nothing is known about the part played by this transient structure.

2. The trabeculæ of the early epiblast reticulum probably serve as pathfinders for the future permanent villi.

3. The absorption of nourishment for the early ovum is probably an important function of the proliferated epiblast.

Recent workers have pointed out that in many mammals the epiblast has a phagocytic action, and it has been supposed that this activity is associated with the absorption of nutriment; hence the name "trophoblast" given by Hubrecht to the layer particularly concerned in the process.

It is extremely likely that the very early disappearance of the surface epithelium on the mucosa where the ovum becomes imbedded is due to the phagocytic action of the outer epiblastic layer. For, it is important to note that, on the surface of the vera in relation to which the fetal epiblast does not enter during the early stages of pregnancy, there is no such rapid disappearance of the epithelium. It takes place there only gradually after weeks, chiefly through mechanical stretching and separation.

4. Besides absorbing the decidual substance, the early trophoblastic prolongations which extend into the serotina probably also absorb the fluids of the tissue. Peters has shown that in the early stage the decidual tissue is very edematous. But, in addition, it is likely that these downward extensions serve another purpose, viz., the establishment of communication between the maternal sinuses and the intervillous space. I was led first to put forward this view from the appearances presented in my specimens of early ectopic gestation. Merttens has also noticed syncytial masses extending into the maternal blood-spaces, without, however, attaching any significance to the appearance. I think that this suggestion is the most likely explanation of the means by which blood circulation is set up in the intervillous space. It is much more reasonable than the belief that there is a haphazard bursting of the maternal vessels, with a consequent pouring of blood among delicate villi which at first cannot have a very firm attachment to the decidua.

The old teaching that the villi themselves dipped into the maternal sinuses is, of course, not to be any longer held. As I have shown, such an occurrence very rarely takes place. This view was based upon a wrong interpretation of the appearances found on microscopic examination.

I have pointed out that several observers have noticed blood in

the intervillous space during the second and third weeks of gestation. Now, if nothing determined the establishment of a communication with the maternal vessels, and if they opened of their own accord, one would expect that the large sinuses in the compact layer of the vera, which are, during the first few weeks as markedly enlarged as are those of the serotina, would rupture also. This does not happen, however, in normal cases.

The very early relationship which is established between the fetal epiblast and the maternal blood, at an early period of the de-

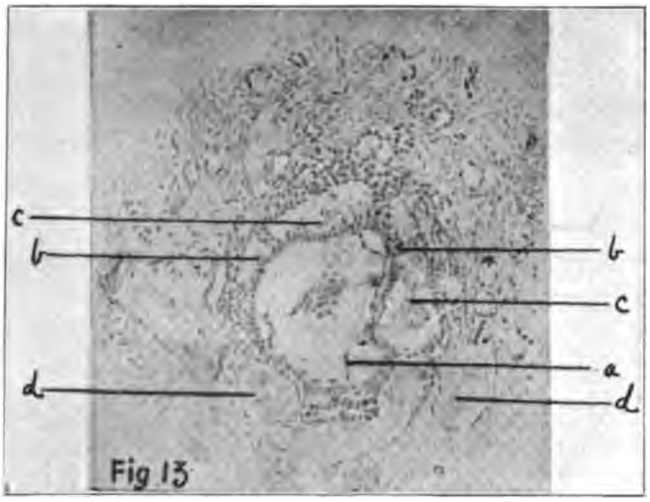

FIG. 13.—Another diagram of Hubrecht, representing the early relationships of the ovum in a specimen older than that described in the preceding figure. *a*, hypoblast of ovum; *b*, trophoblast; *c*, large lacuna in the trophoblast, containing maternal blood; *d*, large blood-spaces in the decidue.

velopment of the serotina, must undoubtedly be explained by the nutritional requirements of the ovum. The yolk-supply in the human ovum must be of insignificant importance, and direct absorption from the decidual substance can not suffice for the rapidly-developing embryo. It is necessary that maternal blood be brought into contact with a large surface of fetal epiblast. In the earliest condition, the blood bathes epiblastic stalks before the mesoblastic layer of the chorion has extended into them with its loops of capillaries.

It is interesting to note that Kossmann, though he has mistaken the nature of the early epiblastic connection between ovum and decidua, has recognized its vacuolation and has described the pouring of maternal blood into the spaces of the reticulum. Hubrecht has shown that this process occurs in the hedgehog and shrew, while M. Duval has amply demonstrated it in several of the rodents, and E. van Beneden in the bat.

This condition might be termed the first or primitive placental arrangements. Duval, who strongly believes in such a method, says: *"Le placenta represente à son origine, une hæmorragie maternelle, circonscrite ou enkystée par des elements fœtaux ectodermiques."* When chorionic mesoblast with its capillaries penetrates the epiblastic stalks, the permanent placental condition has begun to be established.*

Not only do the plasmodial strands open into the decidual sinuses, but they may sometimes spread over their walls, becoming irregularly attached to them, or pieces may be carried away by the blood-stream.

Sometimes at the surface of the decidua, where a sinus opens close to an attached villus, the plasmodial layer on the latter may appear to be continuous with the layer on the villus. It is prob-

* This distinction between a primitive and permanent placental arrangement in the human subject, which I have urged in the case of ectopic as well as in uterine pregnancy, will be noted with interest by those who have read the recent publication of John Beard, Lecturer on Comparative Embryology in the University of Edinburgh, entitled "On Certain Problems of Vertebrate Embryology." This suggestive writer has advanced the thesis that there is an *antithetic alternation in the development of vertebrates,* the transition period forming a so-called *"critical stage."* He has challenged the truthfulness of the well-known data termed "von Baer's law," and puts forward his own views in the following words:

> "There is a stage in the development of every vertebrate embryo, during which, and only then, it resembles the embryo of any other vertebrate in a corresponding stage in certain general features. But, while it thus agrees exactly with any other embryo in this stage in characters which are common to all vertebrate animals, it differs from the embryo of any other class in certain special class features, and also from any other embryo of the same class, but of a different order in other and ordinal characters. Immediately before this stage is reached, it begins to put on generic and specific characters, and thus it then begins to differ from all other embryos in these.'"

He believes that in all Eutherian mammals the transition from the phorozoon or larval stage to the garnetozoon or advanced stage is marked by the change *from the primitive to the permanent connection between ovum and uterus.* Duval and Hubrecht have clearly shown the temporary character of the early epiblastic structures joining ovum and uterus, in several mammals.

ably this appearance which has been wrongly described by several observers as a prolongation of the endothelium from the maternal vessels over the villus. Keibel, Winkler and Waldeyer have recently made this mistake. This error is most likely to be made when the plasmodial layer, which has become attached to the vessel-wall, has become somewhat flattened out.

As I have already pointed out, it rarely happens that a villus extends into the mouth of a sinus. Sometimes the epiblast covering its end may appear to be continuous with the wall of a neighboring sinus, or, sometimes, a growing villus may dip into the mouth of a sinus which has already been opened into and become attached to the sinus-wall. The great majority of the villi, however, are attached to the surface of the decidua. With the advance of pregnancy, the plasmodial layer on the decidua becomes more flattened and broken up. It does not grow with the increase in the surface-area of the decidua. On the villi and chorion, also, the same layer thins, and largely disappears with advancing pregnancy. There is, also, relatively, much less plasmodial material found in the substance of the decidua at the end of pregnancy than in the early months.

CHAPTER VI.

THE CHORION.

The chorion is best described as the outermost covering of the blastodermic vesicle which comes into direct relationship with the decidua serotina and decidua reflexa. At first this layer is entirely epiblast. In the early specimen of Peters a thin layer of mesoblast lies internal to it. Very early it increases in thickness, forming a mass in which vacuolation occurs giving rise to a reticulated structure—the first or primitive placental arrangement.

After the formation of the mesoblast, its somatopleure layer, attached to the inner surface of the epiblast, extends outward in the strands and projections of the epiblast to give rise to the permanent structure of the villi.

This extension probably commences about the end of the first week. Indications of the process already exist in Peters' early case. Minot believes that in Reichert's (supposed) twelve- or thirteen-day ovum the chorion consists only of epiblast. Merttens, however, in his (supposed) six- or eight-day specimen, describes mesoblast as being present. It had entered the villi, also, in both of Leopold's specimens. It must be inferred either that Merttens, Leopold and Reichert have wrongly described the age of their preparations, or that, in Reichert's case, owing to imperfect examination, the exact condition was not accurately ascertained; or that the date at which the epiblast and mesoblast blend is a variable one.

EPIBLAST.

I have already described the arrangement in Peters' early specimen, viz., the great proliferation, sponge-like in character, with many of the reticula filled with maternal blood. Next the ovum these spaces were lined by a thin layer of epiblast, often consisting only of a single row of cells with distinct outlines.

I have also pointed out that syncytium was found only in certain parts, being evidently due to transformation of peripheral layers of the trophoblastic strands.

In Leopold's early specimen, the conditions are somewhat more advanced, more syncytium being found in the shape of buds growing from the chorionic membrane and early villi, as a thin superficial layer on parts of the villi, on the serotinal surface, and as extensions into the latter.

In Merttens' specimen the epiblast consists of two layers, deep and superficial. The former is composed of cubical or somewhat rounded cells, lying in close contact, and with well-marked outlines. The cell-substance stains lightly; the nucleus is rounded or oval and contains a good deal of chromatin. This layer is generally known as Langhans' layer.

The superficial layer consists of darkly staining granular protoplasm, nucleated, but with no distinct cell-outlines. Small projections extend downward between the adjacent parts of the tops of the cells of the deep layer. This layer may be called the *syncytium* or *plasmodium*. It varies in thickness. In some parts it is only about .0026 mm. thick, possessing very small nuclei; in this state it is not unlike an endothelium in appearance. Generally it is much thicker than this, the nuclei being large. The nuclei do not possess much chromatin. Here and there groups of nuclei are seen closely placed together. Merttens describes a finely-reticulated arrangement in the protoplasm of the syncytium. At intervals projections of this layer, varying in size and shape, extend outward from the surface.

The nature of these two layers of cells has been much disputed. Many of the earlier views were based upon the study of advanced specimens of pregnancy. Investigations of recent early cases have discredited them. In particular Peters' specimen has shown beyond doubt the beginning of syncytial formation.

Kastschenko and myself were formerly of the opinion that the earliest condition of the chorionic epiblast was a syncytium. This is not the case, as Peters has shown. The earliest condition is one

in which the cells are distinct from one another. The plasmodial development is due to a transformation of the former toward the end of the first week of pregnancy.

The first description of syncytium was probably given by Fleischmann in his studies of early pregnancy in some of the carnivora.

Kőlliker many years ago supposed that the villi and chorionic membrane received a covering of decidual tissue. As we shall afterward see, decidual tissue only touches the chorionic membrane for a short distance at its periphery in the well-formed placenta.

Langhans, in 1882, studied specimens from the second and third weeks of pregnancy and described the layer of the cells next the chorionic mesoblast, which has since been named after this worker, but which he thought to be of mesoblastic nature. External to these he recognized a syncytial layer, which he described as the fetal epiblastic covering. He also noted the presence of syncytium on the decidual surface. Kastschenko was the first to point out the common origin of Langhans' layer and the syncytium, but he made the mistake of regarding the latter as the earliest form of chorionic epiblast and the Langhans cell as derived from it.

Minot, myself and others also believed in the identity of both forms of cells.

Leopold in his recent work has wrongly stated that the Langhans layer is mesoblastic. Eden also holds this view.

Waldeyer, from his studies of advanced specimens, described the single layer, so often found on old villi, as endothelial.

Lately Fenzi and Johannsen have urged the decidual origin of the syncytium. Peters has tabulated the various views regarding the chorionic epithelium as follows:

1. The epithelium of the villi is a single layer, fetal epiblast in origin.—Kőlliker, Heinz and others.

2. It is a single layer, derived from maternal epithelium.—Turner.

3. It is (in the late stages, at least) a single layer, formed from connective tissue elements of the decidua.—Ercolani.

4. It is a double layer, of fetal origin, the inner layer, consisting of distinct cells, mesoblastic; the outer layer being epiblastic.—Langhans.

5. It is a double layer, the inner being fetal and epiblastic; the outer endothelial and derived from maternal blood-sinuses.—Winkler.

6. It is a double layer, the inner being of maternal connective tissue origin, the outer of maternal endothelium.—Tafani, Romiti.

7. It is double, the inner layer being fetal epiblast, the outer being derived from the epithelium of the uterine glands, in which the villi sink.—Jassinski.

8. It is double, both layers being fetal epiblast, the outer layer being syncytial in nature.—Kastschenko, Minot, myself. Kuper and Spee believe that the outer surface is ciliated.

9. It is a triple layer, the two inner ones being fetal and the outer maternal endothelium.—Keibel.

10. It is a triple layer, all being derived from maternal decidual tissue.—Schroeder van der Kolk.

Ulesco-Stroganova has described an early ovum and has strongly upheld the identity of the two layers—syncytium and Langhans cells. She pointed out the entrance of maternal red blood-corpuscles into the syncytium, noticed its vacuolation, and believed that the fibrin-streak on the surface of the decidua (named after Nitabuch) was due to degeneration of syncytium and decidua.

With reference to the views of those who believe that the syncytium is not fetal, but derived from epithelium of the maternal mucosa, a few words must be said. The careful work of Merttens and Kossmann, who have in recent times strongly advocated this view, is considerably marred by their non-recognition of the part played by the fetal epiblast. Their position regarding the origin of the syncytium is absolutely untenable, in the light of recent work. There can be no doubt that the changes in the surface and gland epithelium are of a degenerative nature and in no way to be associated with an activity which extension over the villi would involve.

It is unreasonable to attribute to dying cells such power as would be necessary to produce the extensive cellular investment found on the villi and chorionic membrane.

Moreover, careful study of the changes found in the degenerating gland-epithelium shows that a debris is formed, entirely different in structure from the syncytium. Formerly, I pointed out that these workers had not recognized the power of the fetal epiblast to destroy and absorb maternal tissue and that, as Hubrecht had shown in the hedgehog the maternal epithelium was destroyed by the trophoblast, so in the human subject there was little doubt that a similar process occurred. Then I believed, like many others, that the ovum attached itself to the mucosal surface, the reflexa gradually closing over it, the surface of the serotina throughout pregnancy corresponding to the original surface of the uterine mucosa.

Peters has, however, clearly demonstrated that the early ovum does not remain on the mucosal surface, but eats its way through the epithelial covering until it becomes buried in the compacta.

The surface of the decidua is, therefore, merely the lining of an excavation, and it has no surface-epithelium from which a syncytium can be formed.

If Kossmann and Merttens were correct, it is very remarkable that the epithelium of the serotina and reflexa should undergo a proliferative development into the layer of syncytium, while that of the vera should show only progressive degeneration and disappearance; whereas in respect to other changes in glands and interglandular tissue in all three deciduæ, there is similarity, during the early weeks.

But it is not necessary to discuss this subject further. The work of Kastschenko, Minot, Peters, myself and others has established definitely the identity of this syncytial layer on the serotina and reflexa with the outermost covering of the chorion; both being, beyond doubt, of fetal epiblastic origin.

The view held by many, that the maternal endothelium extends

over the villi, forming their outer covering, is entirely disproved by the investigation of the early specimens recently published.

There is no pushing of the villi between maternal sinuses. Neither is there evidence of activity in the endothelium of the dilated sinuses. The sections of Peters and others demonstrate that there is rather degeneration and separation of it in places.

Peters has shown that the syncytial lining of the blood spaces in the early trophoblast may resemble endothelium in certain parts, but this is in those farthest from the decidua, in his sections, not in those near the latter. This is because the syncytium is first formed in those spaces which are oldest and largest. Were the layer an endothelium it would be most apparent next the decidua.

Peters has also shown that the outermost trophoblast strands may occasionally push their way external to a maternal sinus so as to lie against its endothelium. This might be misinterpreted as an extension of endothelium over the trophoblast.

Peters' sections show that there is no ground for the view that decidual cells are transformed into syncytium, for in his specimen these cells had scarcely begun to form, and distinct syncytium was most marked near the ovum and not near the maternal tissues.

On the contrary, he has shown the identity of trophoblast and syncytium, and the derivation of the latter from the former on the surfaces in contact with maternal blood. The latter seems to exercise a blending influence on the superficial epiblast cells and the latter seem to assimilate and break up maternal blood-corpuscles.

Peters thinks that the syncytial layer acts as a kind of endothelial lining of the intervillous spaces performing some important part in the function of interchange between fetal and maternal blood during pregnancy. He thinks it also serves to protect the blood from direct contact with the Langhans layer which probably has some destructive or coagulating influence on the maternal blood.

There is no ground for believing that the syncytium serves for the nutrition of the early ovum. Instead of its absorption during the early weeks it becomes more extensively formed.

(Strahl and Heinricius state that in some of the carnivora there is gradual destruction of the syncytium and that it serves nutritional demands. This must be regarded as very doubtful.)

Selenka's description of the villi penetrating maternal glands getting a covering of their epithelium is entirely fallacious.

Von Siegenbeck was inclined to regard the syncytium as distinct from the fetal epiblast, but could find no evidence of its origin from maternal endothelium or epithelium.

MESOBLAST.

In Peters' specimen the chorionic mesoblast is a thin layer varying from two to four thicknesses of cells, somewhat thicker opposite the embryo; the cells are rounded, oval and spindle-shaped. It extends a very short distance into some of the trophoblastic strands which pass toward the decidua.

In Merttens' case its thickness is about .026 mm. It consists partly of mucoid tissue, partly of a homogeneous matrix finely fibrillated, with spaces here and there, partly of delicate fibrils and spindle-shaped cells lying parallel with the surface. The cell-protoplasm stains lightly, the nucleus deeply.

In both of Leopold's specimens all villi save early buds contained a mesoblastic core.

In Reichert's ovum the villi were supposed to be entirely epiblastic. In Merttens' some contained mesoblast, though the capillaries had not formed. In Coste's early specimen the villi were described as solid and partly hollow buds of epiblast, into which mesoblast had not extended. From a careful study of the various early cases which have been published, it is very evident that the period of the first extension of the mesoblast into the villi varies in different cases, or that observers have wrongly estimated the age of their specimens, or, in some cases, wrongly described them.

The earliest described mesoblast has no capillaries. These develop in the villi during the second week, but the exact period is not known. No doubt it varies slightly in different cases.

We have yet to learn the variations in the manner and time of branching of the early villi. Peters has shown that some of the primary epiblastic strands are irregularly branched, though many appear to be simple. In Merttens' specimen they show slight division. Reichert described those in his case as being unbranched.

But, undoubtedly, in all the early specimens the villi are, for the most part, simple. They extend outward as thick stalks of epiblast, mainly at right angles to the chorionic surface and at unequal distances from one another. Some run obliquely. The line of the villus is straight or wavy. In some the free ends are much thicker than the roots. In most the stalks are of pretty uniform thickness. Some of these are merely sessile buds. Several are vacuolated. Here and there irregular or reticulated masses of plasmodium project from the chorionic membrane. I believe that these are the remains of the early-formed reticulum. Projecting from some of the larger villi are also seen processes of irregular size and shape, some of which are vacuolated. Several of these are probably the remains of broken reticular strands.

The earliest villi which connect the ovum with the decidua are the early trophoblastic strands. When these become filled with a mesoblastic core they form the first permanent villus-stems or trunks. Afterward, other villi grow out to the decidua and become attached to it. From these stems many small villi grow, hanging in maternal blood.

During the second week variations are found in the mode of attachment of the villi.

Some are attached merely by the outer layer of syncytium. I believe that these have been formed by the extension of mesoblast into strands of the reticulum attached to the decidua. The great majority become attached by a proliferation of the Langhans layer of epiblastic cells at their ends, forming a thick rounded mass, the superficial layer of plasmodium becoming thinned, stretched and split off. The cells of this proliferated mass (*Zellsaüle*) are irregularly rounded, faintly staining, and possess nuclei rich in chromatin.

When the villi are firmly fixed their outer plasmodial covering on the sides appears generally to be continuous with the corresponding layer in the neighborhood on the decidual side.

As Leopold has shown, a thin layer of fibrin may sometimes be found under the attachment of the villus at a very early stage.

These remarks have applied generally to the whole chorion in its very earliest state. I will now continue the account of the two portions:

Placental Part.

Non-placental Part.

PLACENTAL PART OF THE CHORION.

END OF THE FIRST MONTH.

According to Kastschenko, the villi begin to become more numerous in relation to the serotina during the second half of the first month. They are, undoubtedly at this time, more numerous and more branched than in the earlier specimens. Many run a straight course, but others are somewhat wavy.

Kastschenko has studied the epithelial covering at this period with the greatest care. He describes the outer syncytial layer as possessing a network of delicate threads, the sections of which give rise to a finely granular appearance. The nuclei are irregularly arranged, in some parts scanty, in others massed together. They measure from .005 mm. to .015 mm. (being larger than at the end of pregnancy), and are mostly round or oval. Where the layer is thin the nuclei are elongated and tend to lie parallel with the surface. They stain somewhat unequally, the larger ones being of a lighter shade than the smaller. Over the ends of the villi the syncytium is usually thickest. Buds and strands extend from their sides as processes of various sizes. Some of these contain vacuoles of various sizes; these may either be empty or may contain a finely granular matrix, probably the young mesoblast.

According to Kastschenko the vacuolation begins by the dilatation of one of the spaces of the network which makes up the plas-

modial protoplasm. As it increases in size, the surounding protoplasm is compressed and its nuclei flattened. Kastschenko thinks that the side-processes are not concerned with the increase of the villi, but only the end-processes. I do not agree with him on this point.

At this early period it is to be noted, the chief proliferative activity is in the epiblastic elements of the villi. As pregnancy advances, we shall see that this gradually becomes a less marked feature. The deep or Langhans layer, at the beginning of the third week, consists of a single, or, in some parts, a double row of cells, whose protoplasm stains more lightly than the plasmodial layer; it has a network-like structure of looser texture than that of the syncytium. In some parts this layer seems to be uninterruptedly continuous with the outer one; in other parts only by means of processes between which are found irrugular spaces.

SIXTH WEEK.

The villi are now much more numerous and more branched. They still appear relatively thick. The branchings are found over a greater extent of the villi than at an earlier period. The most noticeable feature about the epithelium, both of chorionic membrane and of villi, is the very small amount of the deep layer *(Zellschicht)* as compared with that of the superficial plasmodium. In many villi no deep cells can be found at all in parts, even though the core of mesoblast may be present. Here and there in the syncytial layer of the chorionic membrane small vacuoles can be seen. In some parts, also, it shows a slight tendency to split, while, in patches, it takes on a very deep stain—the early stages of the degeneration which has been particularly described by Langhans. A few small knot-like projections of the epithelium may be seen at intervals, but these are far more numerous on the villi. The villus-stems are mostly oblique to the surface, though some are at right angles to it.

The chorionic mesoblast is more fibrillated than in earlier speci-

mens, and in parts has a dense appearance. It contains more numerous spindle-shaped cells, which, for the most part, lie parallel to the surface. In different places these cells are arranged under the Langhans layer of the epiblast as a kind of basement membrane, the distinction between the two thus being clearly evident. In the villus-stems the mesoblast is most condensed at the periphery and at the outer ends. In the small villi it is quite loose, of the delicate mucoid type. In the very youngest villi the mesoblast is very finely granular, faintly staining and vacuolated. Here and there irregular branching cells with round nuclei are found. Leucocytes are found in the spaces. Most of the villi have capillaries; these consist simply of a tube of small, flat, endothelial cells around which the connective tissue is somewhat condensed, though to a different extent in various places.

Among the villi are to be noticed free pieces of syncytium, irregular in shape and size, presenting the same appearances as the buds and processes attached to the villi. They are evidently sections of the latter.

A few irregularly-rounded masses of considerable size are found lying among the villi—the *Zell-Knoten* of Langhans. This observer believed them to be derived from maternal tissue, while Kastschenko thought them to be formed from villi.

So far as my observations go, I am able to distinguish three varieties of *Zell-Knoten*. One consists of undoubted decidual cells along with a mass of cells which evidently belong to the proliferated *Zellschicht* at the end of an attached villus. Around the whole mass, or on parts of it is a layer or masses of syncytium; some of this same tissue may be scattered throughout the mass. Attached to it may be found one or more pieces of villi. In the decidual elements of this mass fibrinous or hyaline degeneration may be found. This variety of *Zell-Knot* is evidently only the appearance presented by a section through an elevation of the decidual surface with an attached villus-end. Sometimes sections of more than one villus-end may be shown. It may be found close to the serotina or at some distance from it lying among the villi.

The second variety of *Zell-Knot* is simply the section of several villi packed closely together along with several processes or strands of the syncytial layer. In these masses no decidual cells are found.

The third variety consists of villi surrounded by fibrin.

The villi which are attached to the serotina are separated by no regular intervals. They are relatively closer than at the end of pregnancy. They vary in size, and may join the serotina by the main end or by branches. They are oblique or at right angles to it; frequently a considerable extent of a villus may become attached either directly by the side or by two or more lateral branch-villi. The latter condition is, however, rare. In the great majority the mode of attachment is the same, viz., by means of the proliferated mass of the cells of the Langhans layer at the villus-end. In some cases there is little proliferation, the attachment appearing not to be very firm. The superficial syncytial layer takes no part in the attachment. It gets thinned and stretched outside the deeper structures of the swollen villus-end, and in this state has been wrongly described by Keibel and others as endothelium from the maternal sinuses in the decidua prolonged over the villus. At the very end of the villus, broken-off bits may be pushed by the villus against the decidua, where they may remain for some time.

The end of the villus appears to sink for a slight distance into the decidua. In some cases its outline is quite distinct. In others it may be so blended with decidual tissue that the distinction is difficult to make out.

It is very probable that the villus-ends, by means of their epithelium, can absorb decidual tissue. Hart and Gulland have noticed special decidual degeneration around the attached ends. I am not able to corroborate this. It may be found in some parts, but not in others, and where it is found it may be entirely independent of the villi.

A few villi only are attached by syncytial stalks. In these there may be little or no proliferation of the Langhans layer. I regard these as remains of early-formed plasmodial stalks which have not been completely penetrated by the mesoblastic core.

Villi attach themselves indiscriminately to elevations and depressions in the decidual surface. In some cases where there is a pit-like depression, it may be occupied by a villus, which, later may be considerably compressed by surrounding tissue.

This appearance may be erroneously interpreted as the boring deeply into the decidua of a villus. As far as I can make out, such a process occurs in most cases of villus-attachment only to a very slight extent. The capillaries of the villi generally extend throughout their whole length, but in some they do not reach the ends.

FOURTH MONTH.

The connective tissue of the chorionic membrane is denser and more fibrillated, especially close to the epithelium. The epithelium, on the whole, is slightly thinner. Here and there it is irregularly thickened. In some parts it and the adjacent connective tissue are infiltrated with leucocytes. The large cells of the Langhans layer are somewhat separated in parts. Occasionally the syncytial layer is found slightly split off from the deeper layer. Fibrinous or hyaline degeneration is seen in varying degrees of advancement. In several places the syncytial layer is very thin.

Many more small villi are seen than at an earlier period. The older villi and villus-stems possess denser connective tissue; it is especially condensed around the vessels. The syncytial layer of epithelium on the villus-stems is very thin as a rule; in some parts staining lightly. The cells of the deep layers are somewhat numerous. All stages of new villus-formation can be found. Among the villi in the maternal blood bits of syncytium of various shapes and sizes are seen. The distance between attachments of villi to serotina is relatively greater than at a very early period of gestation.

SIXTH MONTH.

The connective tissue of the chorionic membrane is denser; its cells are mainly spindle-shaped. The epithelium is thinned. In some parts it is quite stripped off. In others only a thin layer of plasmodium is found with scattered cells of the Langhans layer be-

low. In other places a well-marked Langhans layer of one or more rows of cells may be seen. Very few buds are found projecting from the chorionic surface, and they are mostly degenerated. Marked hyaline or fibrinous alteration in different stages is found widespread in the epithelium.

There is a relatively larger number of villi; they are more slender and more branched than in the earlier months. In the villi the syncytial layer of the epithelium is the most prominent. It is to a considerable extent flattened, the long axes of the nuclei being parallel to the surface. In many parts it is greatly thinned, no nuclei being visible. Growths of buds from the sides of the villi are much less numerous than in the earlier months. Fewer syncytial masses are seen in the intervillous space.

The attached ends of most of the villi have an appearance very different from that found early in pregnancy. The proliferated mass of the Langhans layer has greatly diminished. In some cases the cells have entirely disappeared, the connective tissue of the villi being in direct contact with that of the decidua. Where the latter in some parts is undergoing fibrinous degeneration this process may extend also to the tissue of the villus. Here and there some cells of the proliferated Langhans layer are found; their matrix stains faintly and appears hyaline, their nuclei being more or less degenerated.

END OF PREGNANCY.

The connective tissue of the chorionic membrane is very dense, in some parts having a sclerosed appearance. There is a relatively large quantity of the matrix in proportion to the cells. Many cells are shriveled and lie in spaces. In many of the vessels great thickening of the intima is found.

The epithelium in many parts is entirely absent, the connective tissue being in direct contact with the maternal blood of the intervillous space. In other parts it consists of a single row of cells belonging either to the superficial or deep layer. The nuclei are flattened parallel to the surface. Where the epithelium is very

thin it greatly resembles an endothelium. Where two or more thicknesses of cells are found it generally shows a tendency to split. In various parts a thick, deeply-staining fibrin-layer occupies the place of the epithelium. Imbedded in this are sometimes found one or more villi massed together. These included villi lose their covering epithelium, their connective tissue gets very dense, and their vessels become obliterated. Under the fibrin no cells of the epithelium can be found in many parts, but elsewhere they are found in varying numbers. The fibrin varies in appearance. It may be dense and fibrillated or it may have a loose reticulated structure as if it were being broken up. Through it epithelial cells in different stages of degeneration may be seen.

The villi are relatively more attenuated than at earlier periods. In the larger ones the connective tissue is mainly dense. In some this appearance may be uniform; in others irregularly distributed, being especially marked around the vessels. In some parts there appears to be a proliferation of the connective tissue on the outer wall of the vessel. The dense tissue sometimes appears smooth and homogeneous on section; this is due to the close packing of fibrils. In the small villi the connective tissue is for the most part loose and mucoid.

Many of the vessels are diminished in caliber, owing to thickening of the intima; this is especially so in the case of the large villus-stems. The vessel wall may occasionally be found to be in a condition of hyaline degeneration. The endothelium is swollen in some parts and proliferated in others.

The epithelium covering the villi has changed considerably from the condition in which it is found in early pregnancy. In most cases it consists of a layer of thin protoplasm with low cubical or flattened nuclei. It is evidently the remains of the outer syncytial layer of the epithelium, for no cell-outlines are recognizable as a rule. The nuclei may be close together or at varying distances apart; they are finely granular and stain very deeply. At intervals the syncytium is thickened. In many parts it is degenerated and is split up. Sometimes a considerable length may appear split off

as a layer. This has been wrongly described by Jassensky and others as a special covering. Here and there the connective tissue core of the villus is quite bared. Very few buds of epithelium are seen, and in the blood of the intervillous space, very few detached bits of syncytium are found. In all the villi very few cells of the deep layer or Langhans layer are visible; they are separated by considerable intervals.

The villi differ in appearance according to the state of their vessels. When containing little blood their outer contour is generally irregular and crumpled. When congested it is more uniform and regular.

In most of the villi attached to the decidua the proliferated cells of the deep layer at the villus-end have disappeared, so that the connective tissue of the villus is in direct contact with the decidual tissue. Where the latter is in a condition of hyaline or fibrinous degeneration, the line of demarcation may readily be made out. Where the degeneration has spread to the villus or where no degeneration exists in either, it is very difficult to distinguish fetal from maternal tissue.

Owing to the thinness of the serotina in parts the attached villi may be very close to the muscular part of the wall. Occasionally the decidua is entirely absent and the villi touch the muscle.

CHAPTER VII.

CHORION.—(Continued.)

NON-PLACENTAL PART OF CHORION.

FIRST MONTH.

In the early specimens, *e. g.*, Merttens', no distinction can be established between chorion frondosum and chorion læve, either in regard to number, size, shape of villi, or of minute structure. The description already given of the early placental portion will, therefore, serve for that of the non-placental portion.

The first change by which a distinction can be established probably begins before the end of the first month of gestation. It is the growth of villi relatively greater in relation to the secotina than in relation to the reflexa.

As regards the minute structure at this time, there is nothing special to be noted. The epiblast, mesoblast and the relationship between fetal and maternal parts are the same as in the placental portion of the chorion.

SIXTH WEEK.

The chorionic membrane is the same as in the placental part. Near the serotina villi are numerous so that a narrow intervillous space exists here between the reflexa and the chorion. This space varies in size in different cases. Farther out from the serotina the chorionic membrane is in closer relation to the reflexa, being either in contact with it or separated by the scanty villi compressed between them.

The villi vary considerably. Near the serotina they are most like those of the chorion frondosum and they are attached in the same manner to the decidua. Farther out from the serotina the villi are simple, less branched and possessing very few buds on

them. They have no marked growth-tendency. Most of them are poorly vascularized, many of them containing no capillaries.

In many the connective tissue has a swollen or hyaline appearance.

Some are attached to the reflexa by a slight epithelial proliferation. In others this can not be found. By this time, as has already been pointed out, the reflexa shows considerable hyaline or fibrinous degeneration. Here and there a villus is imbedded in a depression of the reflexa, its epithelium degenerated or largely wanting, its connective tissue hyaline and swollen.

By this time, in the great majority of cases, the reflexa is in close apposition with the vera, with which it becomes blended. Union occurs irregularly and not continuously. The reflexa is usually very thin and in some parts may be broken so that the chorionic epithelium lies in direct contact with the vera. Nowhere can any traces of the epithelium which formerly covered the vera be found.

The chorionic epithelium at the time of blending is somewhat thicker than in the second month. The cell outlines can be distinctly made out in most places. Where they lie next to well-formed decidual cells the distinction between the two can not easily be determined. The cell substance stains lightly, the nucleus deeply. Here and there syncytial structure can be made out.

The line of attachment varies; it may be regular, slightly or very uneven, following the elevations and depressions of the decidual surface.

Remains of degenerated villi are found, compressed between the chorion and decidua. In most of these the superficial epithelium is destroyed, the mesoblastic core having a fibrinous or hyaline appearance.

Now and then a case is found in which during this month there may be no blending whatever between the vera and reflexa. This may be found even when a well-formed portion of the placenta has developed in connection with the reflexa.

SIXTH MONTH.

The chorionic membrane is almost everywhere adherent to the decidua. The chorionic connective tissue is fibrillated, the nuclei being elongated and lying parallel to the surface. The epithelium which forms the means of attachment is a well-marked layer varying in thickness, but on the average, thinner than it was at the fourth month; it is rare to find more than two rows of nuclei. A few villi may be found compressed between chorion and decidua. Their connective tissue has a dense swollen appearance as if undergoing hyaline degeneration; no vessels are visible in them. Occasionally non-union of portions of reflexa and vera may be found.

FULL TIME.

The chorionic connective tissue appears much the same as at the sixth month, though it is generally denser. The line of attachment to the decidua is very similar. The epithelium is thickest close to the placenta, where from three to nine rows of nuclei may be found. The nuclei are in general round or oval, but they are also found irregular in outline, often lying in a space in the matrix. The latter stains faintly, has a finely granular structure and is vacuolated and broken up in parts.

Away from the placenta the epithelial layer is thin and presents various appearances of degeneration. Here and there, especially near the placenta, degenerated remains of villi are found, compressed between chorion and decidua.

THE RELATION OF THE VESSELS OF THE MUCOSA TO THE INTERVILLOUS CIRCULATION.

It has been clearly demonstrated by Peters' specimen that as the ovum breaks through the surface of the mucosa and imbeds itself in the compacta, there may be a small extravasation of maternal blood around the ovum. In his case it formed a clot over the outer polar portion at the site of entrance through the surface mucosa.

Peters supposes that this blood furnishes nourishment to the ovum. Whether this clot-formation always occurs can only be settled by the examination of other early specimens. It may only be accidental in Peters' case.

His sections establish, however, very clearly what my previous work has led me to suppose as to the earliest stage in the development of a relationship between the chorion and maternal blood. This I have already described in detail. The great multiplication of the chorionic epithelium to form a trophoblast layer is accompanied by the formation of spaces in the latter, into which maternal blood finds its way.

That the opening of the maternal sinuses is chiefly due to the phagocytic action of the trophoblast can scarcely be doubted.

These spaces in the trophoblast are the beginnings of the large intervillous space of the well-formed placenta. Owing to their communication there is very early developed a circulation around the whole chorionic surface of the ovum.

As pregnancy advances this circulation gradually becomes limited to the chorion frondosum, or that part which enters into the formation of the placenta.

Occasionally, however, a small or large portion of the chorion læve may remain, developing continuously with the frondosum, and the maternal blood may circulate among its villi, giving rise to a reflexal placenta.

In the permanent condition I have shown that the villi are attached mainly by their ends to the surface of the decidua. They do not force their way through the walls of the maternal sinuses, so as to hang naked in them, or to become covered by an investment of the endothelium which they have pushed before them. These old views must be entirely abandoned. As I have pointed out, it is very exceptional to find a villus hanging into the open mouth of a sinus at the surface of the decidua or attached to its walls.

I have also demonstrated that there is no extension of the endothelium of the maternal sinuses outward so as to form a covering for the villi, and I have shown that this view has been based

on an incorrect interpretation of the appearances seen in sections. Recent careful histological methods have shown that the covering of the villi, long termed "maternal endothelium," is really "fetal epiblast."

I now wish to notice particularly the condition of the maternal vessels which communicate with the intervillous space. It is very evident that, as the maternal blood circulates among the villi, giving up its oxygen and nourishment to the fetal blood in the villi, there must be openings in the serotina through which the current flows toward the villi and others through which it flows from them into the maternal venous system.

Much has been written on the nature of the serotinal vessels and their relationship to the intervillous space. Attention may be particularly directed to the work of Waldeyer, Turner and Bumm. It is usually stated that both arteries and veins open into the intervillous space. I object to the use of these words and would substitute "afferent" and "efferent" vessels instead.

There can be no doubt that in normal cases it is rare to find a vessel worthy the name of artery or vein in the superficial part of the mucosa. They are mainly capillaries, having lost their muscular and elastic coats deeper down. One does find a few small vessels to which the term "arteriole" may be applied, consisting of a lining of endothelium surrounded by one or two layers of somewhat flattened connective tissue cells. These conditions are found in the non-pregnant uterus as well as in early pregnancy. Block, who has particularly studied the vessels of the mucosa in eight specimens of pregnant uterus, is of exactly the same opinion as myself on this point.

One of the earliest changes in pregnancy is the dilatation of the capillaries in the superficial layers of the decidua, giving rise to large sinuses. The arterioles and venules which communicate with these are also somewhat increased in size. Microscopically, it is impossible to distinguish these arterioles and venules from one another, and I am at a loss to know how certain observers have so confidently figured vessels in their drawings as one or the other.

Neither can I give any support to those who describe a particular and definite arrangement of the afferent and efferent vessels, *e. g.*, Bumm, who, in a recent paper, gives a diagram representing the afferent vessels (called "arteries" by him) opening into the intervillous space on the sides of the outward prolongations of the decidua (called by him "intercotyledonary septa"), and the efferent vessels (named "veins" by him) opening from the surface of the decidua between these prolongations. His beautifully figured artery coiling outward in a decidual hillock, and then sending jets of red paint outward among the villi must be regarded only as a pretty fancy.

No such systematic and orderly arrangement can be found. Afferent as well as efferent vessels open indiscriminately on the decidual surface between the decidual elevations as well as on them, as Farre long ago pointed out; and, for the most part, the openings occur between those narrow prolongations of the decidua to which the term "septa" has been applied. Kölliker, indeed, could find no arterial openings in these septa. They are generally poorly vascularized. Indeed, if the afferent blood alone proceeded from them the villi would be but poorly nourished.

The vessels by which blood enters and leaves the intervillous space are practically entirely the large sinuses—dilated capillaries of the compact layer of the serotina. The opening of communication will direct an afferent or efferent current, probably according to whether it is nearer the arterial or venous end of the sinus. It is very rare for a small arteriole or venule to open directly into the intervillous space. As to the number of openings in a full-time specimen, we have no accurate information. Attempts have been made to estimate them. According to Waldeyer, they are most numerous in the central portion of the area serotina.

As to the physics of the intervillous circulation, it is very evident that the windings of the small arterial vessels through the muscular part of the uterine wall and the deeper part of the mucosa must be associated with a diminution of the force with which the blood is poured into the intervillous space. The capillary-

dilatation forming large sinuses must also assist in diminishing the force of the current. The reason of this weakening is very evident. Were the arteries to run a straight course and to open directly into the intervillous space without the interposition of blood-sinuses, the jets of blood would probably be a source of danger to the villi, tearing them across or separating them from their attachments.

The condition of the veins in the mucosa is such as to favor the removal of the deoxygenated blood as rapidly as possible; they have not the tortuosity of the arterioles, but run a more simple course.

In conclusion, it may be noted that the intervillous circulation is so conditioned as to be largely independent of sudden changes in the maternal vascular system. It is probably not a swift-flowing, pulsating stream, but a steadily-moving mass of blood. Evidently the least motion will be at the parts most distant from the openings, *i. e.,* the surface of the chorionic membrane. Variations in resistance will also be found next the decidual surface, according to the number and position of the openings of the maternal sinuses in it.

THE AMNION.

At what period in the human ovum the folds of the extra-embryonic somatopleure develop giving rise to the amnion, we are uncertain.

Peters says that the amniotic cavity was completely closed in his early specimen.

Merttens states that in his early specimen (? 8 days) there was no amnion. In his (? 14 days) the amniotic cavity was completely formed. So was it in Schwabe's (? 13-15 days) and in Spee's (second week).

As to the structure of the first-formed amnion we can not speak with accuracy. In Peters' case the amniotic cavity was lined with a layer of very flattened cells opposite the embryo and with cylin-

drical cells next it. Outside was a layer of mesoblast, consisting of several thicknesses of cells.

In Spee's early case (second week) the amnion consisted of a single layer of flattened cells—the epiblastic portion and a single layer of flattened cells close to it, the mesoblast.

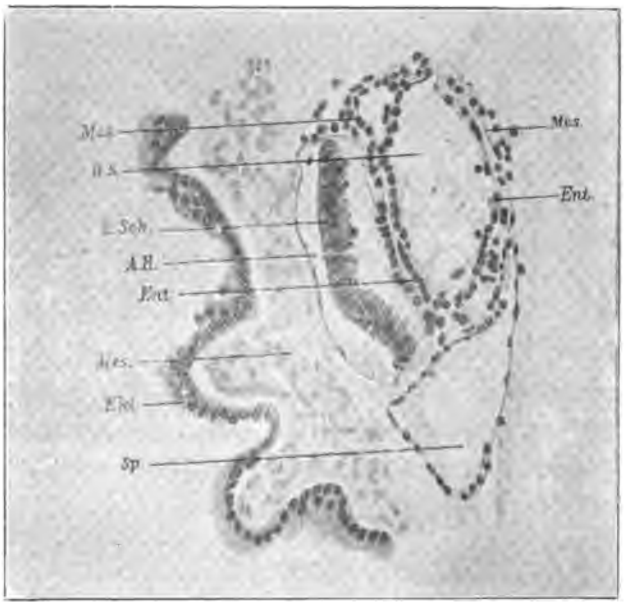

Fig. 14.—Section through embryonic region of ovum. First week of pregnancy. *E.Sch.*, embryonic epiblast; *Ent.*, embryonic hypoblast; *Mes.*, mesoblast; *D.S.*, umbilical vesicle; *A.H.*, amniotic cavity; *Ekt.*, chorionic epiblast; *Sp.*, fold in exocœlum.—(H. Peters.)

It will be of extreme interest to trace changes in the epiblastic cells from their somatopleure condition, and to compare them with the changes in the development of the chorionic epithelium.

THIRD AND FOURTH WEEKS.

The epiblastic layer is not unlike an endothelium, so flattened are the cells composing it. In many parts no lines of division can be distinguished between the cells. The distances between the nuclei vary. The latter are rounded or oval. The cell-matrix

stains faintly. Here and there one sees more than one row of nuclei.

The mesoblastic tissue varies in thickness. It is composed of an outer layer very similar in appearance to the epiblastic layer and termed the *mesothelium,* and an inner layer lying next the epiblast, composed of a homogeneous faintly-staining material, finely fibrillated, in which very few cells can be seen; the latter are close to the mesothelium and are probably formed from the cells of the latter.

It is evident, therefore, that from the early period in which the amnion was composed of two rows of cells, one epiblastic and the other mesoblastic, there has been an advance, viz., the formation between them of the homogeneous matrix from the mesothelium.

SECOND MONTH.

During this month the epithelial and mesothelial cells become scarcely altered. The matrix between them is increased. It is somewhat condensed and fibrillated, especially next the epiblast, and looser next the mesothelium. Cells are scattered throughout it—oval, fusiform and branching in character. Many of the cells appear to lie in lacunæ. In many parts the direct continuity of the mesothelium is broken, its cells being loosely scattered among the neighboring loose fibrils. Only here and there is there any attachment to the chorionic mesoblast by means of delicate fibrils.

FOURTH MONTH.

The epithelial cells are relatively more numerous; they are less flattened and more packed together, being cubical mostly, or, in some instances, columnar. The original flattened cell is rarely found.

The connective tissue still presents a dense homogeneous appearance next the mesoblast. It varies in thickness, and may contain only a few irregularly-scattered cells, or they may sometimes be found in small rows. The loose layer also varies in thickness, but,

on the whole, it is somewhat more abundant than in the early months. In some parts this layer may not appear loose because the fibrils are so closely packed together. Very few remains of a distinct mesothelium are found. There are more marked strands connecting the connective tissue with that of the chorion; very few cells are found in these.

SIXTH MONTH.

The epithelium has not altered to any extent. During this month more condensation is found in the loose layer of the connective tissue. Relatively fewer cells are found in it. They are mostly fusiform, though others are found, rounded, oval or branching. Traces of a mesothelium can be found. Here and there the connective tissue may be quite fused with that of the chorion, but in most parts the connection is by means of loose strands.

FULL TIME.

The epithelium is mainly cubical, but in different places it is markedly columnar, the nuclei of the latter being in the outer parts of the cells. The lines of division betwen the cells are, as a rule, only faintly marked.

On surface view, the cells appear irregularly rounded or polygonal in outline, broader in diameter than they are in their vertical measurement.

Most of the cells possess only one nucleus; some of the larger ones have two. Lange has pointed out the occurrence of groups of cells, as seen on the surface view, arranged either as a double row or as a group concentrically arranged around a point. These cells are large, of various shapes, and their nuclei are placed in their outermost parts, *e. g.*, farthest from the center of the group.

On careful examination, the edges of the cells are seen to be very irregular, the projections of the adjacent cells blending so as to form bridges between the cells. This gives the well-known "prickle" appearance.

Stomata have been described among the cells by various au-

thors, *e. g.,* Hüter, Winkler and Windgradow. Lange has studied these openings carefully and he believes that they are simply lacunæ formed by the breaking down of degenerating cells. It is difficult to come to an opinion regarding these openings. Apart from these large communications, it is extremely likely that between most of the epithelial cells, minute channels exist, through which fluids may pass.

At this period of gestation the condition of the connective tissue is much the same as at the sixth month. Very seldom can any distinct remains of a mesothelium be traced. In most parts the connective tissue is losely connected with that of the chorion. The loose connecting strands are called the sub-amniotic layer by Barbour. Here and there is firm union so that no distinction can be made out. As Minot has pointed out, the nuclei of the connective tissue cells are more irregular in the late months of pregnancy. They become granular and tend to break up somewhat.

CHAPTER VIII.

THE PLANE OF SEPARATION OF THE OVUM.

In this section I give the results of my studies of completely expelled ova at various periods of pregnancy, from the fifth week to full time.

FIFTH TO EIGHTH WEEK.

An examination of complete abortion-sacs at this period shows that, usually, the plane of separation takes place through the outer part both of the compact layer of the serotina and vera (between the middle and outer third of this layer). In parts, most of the compact layer or, indeed, the whole of it, may be shed; here and there small portions of the spongy layer may also be torn through. Very seldom is any extent of spongy layer separated. The surface of the expelled ovum, it is evident, varies considerably. Considerable portions of it are quite smooth; others rough and slightly shaggy.

THIRD TO FOURTH MONTH.

In specimens from this period the separation plane of the placenta is found to vary also, though for the most part, it is through the outer part of the compact layer of the serotina. Where this layer is very thin it may be entirely removed and some portion of the spongy layer as well. But it is rare to find any large amount of spongy layer removed.

The membranes separate through the outer part of the compact layer. The plane is somewhat irregular. Generally only a thin layer is removed. The greatest thickness removed is found near the placenta.

FIFTH TO SEVENTH MONTH.

The plane of separation is still through the compact layer.

Owing to the general diminution in the thickness of this portion, the amount of compact layer left behind in the uterus after the escape of the ovum is very thin, and one finds more frequently than in the earlier months that strips of the spongy layer are removed.

AT FULL TIME.

The maternal surface of the expelled placenta is probably considerably more irregular than it is *in situ* before delivery. The alteration is, of course, due to the compression which it undergoes during delivery and to the escape of blood, both from the intervillous spaces as well as from the fetal vessels of the cord (*i. e.*, in cases where the cord is cut and not tied).

In frozen sections of the pregnant uterus the maternal surface always appears more regular than in the born placenta. This difference is also seen when a placenta is artificially removed from a uterus in the cadaver. It is not so irregular on the uterine surface as the naturally-born placenta.

An examination of the separation-plane of the born placenta shows that, between the depressions and fissures it is fairly smooth, though several rough patches may be found. This is owing to the fact that separation occurs mainly through the compact layer or through its junction with the spongy layer. Only here and there are any considerable portions of spongy layer removed. The amount of decidua removed varies considerably, however, not only owing to the differences in the site of the separation plane, but also to the variations in thickness both of the compact and spongy layers of the decidua at full time. It will be necessary, therefore, to recall in this connection what has been pointed out regarding the condition of the decidua at the end of pregnancy. In some parts no compact layer whatever is removed, simply because before labor it has been entirely absorbed. In other parts no decidua of any kind may be removed, because it may have been so greatly thinned that the villi lay close to the muscular part of the wall.

It is very evident, therefore, that the view held by many, viz.,

that the placenta normally separates through the deep part of the spongy layer can not be regarded as correct.

The separation plane of the membranes is also mainly through the compact layer. The amount removed varies greatly. In general it is very small, though often none is removed. Here and there bits of the spongy layer are torn off. The nearer the placenta the more decidua is found on the membranes. My observations are not in agreement with those of Langhans and Barbour, who state that the separation plane of the membranes occurs mainly through the spongy layer.

According to Priestly and Leopold, artificial separation of the membranes causes the tearing to occur mainly through the spongy layer. This is what would be expected.

Placenta and Membranes in the Porro Uterus.

We are not yet in possession of descriptions of the microscopic appearances seen in the third stage of labor, *i. e.*, during the actual process of separation of placenta and membranes.

Of considerable interest are the conditions found in the uterus removed by Porro's operation. I have carefully studied one of these but can add nothing to the admirable account of the two specimens given by Barbour.

In all of these specimens the uterine body was retracted so as to closely embrace the placenta and membranes, but no separation had taken place. As regards the relation between placenta and serotina, it is interesting to note that both had considerably diminished as a result of the retraction. Associated with this change, there was a greatly diminished quantity of blood in the intervillous space, while the villi were closely packed together. These points are very distinctly seen when Porro sections are compared with those made from the normal full-time pregnant uterus. The great diminution in the size of the placenta which takes place during the third stage is made possible by the escape of the maternal blood of the intervillous space into the systemic circulation during retraction

and contraction of the uterus, partly also by the forcing of the blood in the villi into the vessels of the cord and fetus. The diminution of the serotina is possible because of the loose reticulated structure which forms the greatest portion of it at full time. Before labor begins the spaces are flattened more or less obliquely or parallel to the muscular layer of the uterus. During retraction they become somewhat crumpled and irregular; and, in parts, the serotina may appear, consequently, to have become somewhat more thickened.

In regard to the relations of the membranes, the main feature is the peculiar disposition of the decidua vera along with the closely attached chorion into a series of folds, along with a similar arrangement in the amnion, though the latter is entirely independent of the former, save where amnion and chorion are closely united. The foldings are not uniformly marked. They are narrower and more numerous in the amnion. The chorionic decidual folds vary according to the thickness of the spongy layer. Where this is scanty, very slight folding occurs. The independent arrangement of the amnion is made possible by the presence of delicate strands connecting the amniotic and chorionic connective tissue in such a large extent.

Post-Partum Uterus Immediately After Delivery.

At this period the decidua is arranged very differently from the condition in which it was found before labor. Owing to retraction and contraction, notwithstanding the amount removed along with the placenta and membranes, it is considerably thicker on the average. This is most marked in the placental area.

The surface of the placental area is irregular, being thrown into a series of irregular elevations and depressions, owing to the crumpling which has taken place. Its thickness is mainly made up of the strands of the spongy portion; remains of the compact layer exist as a thin layer at the surface. Though very spongy in nature the arrangement of spaces and trabeculæ is very different

from that which existed in the preparturient condition. Then the spaces were mainly flattened parallel with the muscular wall of the uterus. In the post-partum condition the spaces are very irregular in size and shape and are no longer mainly parallel with the muscle. The vessels of the decidua are greatly contorted and compressed in many directions. In a considerable number of places the trabeculæ appear to have been torn across. All of these changes are consequent upon the retraction and contraction of the uterus.

In the non-placental area the decidua is thinner, but it is arranged in much the same manner.

In both areas may be found patches where the musculature is quite bare. These are either parts from which the decidua had been entirely absorbed by the end of pregnancy and which had not been entirely obliterated during the diminution in size of the uterus through retraction and contraction, or the decidua had been very thin and had been removed along with the placenta or membranes.

RESUME.

My observations regarding the separation plane of the ovum may be summarized as follows:

In the early months of pregnancy when a complete abortion occurs not associated with any inflammatory changes in the uterus, the plane of separation of the ovum is mainly through the compact layer of the serotina and vera in its middle or outer layer; in certain parts the whole compact layer and bits of the spongy may be shed. It is exceptional to find any considerable quantity of the latter removed.

(In abnormal cases, *i. e.*, incomplete abortions, the entire vera may be left behind, with or without the reflexa and reflexal villi, the separation plane extending only through the outer layer of the serotina. In other cases only parts of the vera may be left. In other cases parts or the whole of the serotina may be left with a portion of

the reflexa, along with attached villi. In other cases these irregularities may occur in combination.)

In later months, when a complete miscarriage occurs, the separation plane is, also, mainly through the compact layer; only here and there are the whole layer or parts of the spongy portion removed. (In abnormal cases, *i. e.,* in which the miscarriage is incomplete, large or small parts of the vera may be retained, along with varying quantities of chorion and amnion. Or a portion of the serotina may be left behind along with placental tissue. In some cases these irregularities may occur together.)

In the late months of pregnancy and at full time, the plane of separation is, also, mainly through the compact layer. But owing to the thinness of this layer, it happens more often than in the early months that separation takes place as well through the junction of compact and spongy layers or through the outer part of the latter. The thickness of that part of the compact layer found on the removed placenta varies somewhat, because, as we have seen, in the preparturient condition considerable variations are found in the degree of development of the whole compact as well as of the spongy layer. (In incomplete deliveries the same irregularities are found as were described in the last paragraph.)

The body of the uterus, after complete delivery of the ovum, has still attached to its inner surface the main thickness of the decidual tissue which was present before labor began, though it is completely rearranged owing to uterine retraction and contraction.

My observations, then, tend to confirm the statement of Friedländer, who, many years ago, stated that the plane of separation was usually found in the compact layer.

The credit of having first described the post-partum uterus as being lined by a layer of decidua probably belongs to Wm. Hunter. Cruveilhier, Heschl and others wrongly taught that the entire muscular wall was laid bare. I have already shown that this only takes place, in normal cases, to a very limited extent.

CHAPTER IX.

THE SHED PLACENTA.

The shed placenta is smaller in area and thicker than it is *in situ* before labor. This is due to the compression of the organ during labor, maternal blood being forced to a large extent out of the intervillous spaces, the volume of fetal blood in the villi also being reduced.

As it appears at the end of the third stage it is best described as discoidal. A considerable range of variations are found as regards its size, shape, color and consistence.

On the average, in the case of single pregnancies it is somewhat rounded, and measures crosswise about seven inches. In its central portion the thickness is, on the average one inch. It usually thins gradually toward the edge. Sometimes, the thickness is fairly uniform until near the edge, when it suddenly diminishes. In some cases the thickness varies considerably in different portions. Its weight varies a good deal; ordinarily from twelve to twenty ounces.

Its outline is often oval, but is sometimes ovoid, reniform, crescentic, or lobed.

One or more detached portions may ocasionally be found—*placenta succenturiata.* The separated mass may be related to maternal blood, just as in the main part of the placenta. Rarely, the detached portion may be as large as that to which the cord is attached, explaining what is sometimes described as a double placenta with a single fetus.

In such a condition the cord may end in the membranes between the placental portions, its vessels going to each.

Sometimes, the villi of the separate portion are functionless, the mass being termed *"placenta spuria."*

In some cases, the placental portions appear to be developments of the chorion læve.

Very rarely, the placenta may extend ring-like around the uterus, being thus similar to the condition found in some lower mammals. Sometimes it has a gap in its substance—*"placenta fenestrata."*

The consistence of the placenta is variable. It may be quite firm or very soft and plastic.

The uterine surface varies in appearance. It is usually dark red, but it may be quite pale.

Ordinarily, it consists of a number of irregularly-rounded convex areas with fissures running between them. These areas are generally termed *cotyledons*. It is, however, very rare that any distinct cotyledonary arrangement exists. The fissures are usually shallow, extending only a short distance into the substance of the placenta.

Occasionally, they may divide half or more of its thickness. They vary greatly in number, and, consequently, the areas between them vary greatly in size.

This surface is usually said to be rough and shaggy. This is, however, an inexact description. A very large portion of it is fairly smooth. As I have already pointed out, in speaking of the separation-plane of the ovum, the maternal surface of the shed placenta represents a plane passing through the compact layer. This is not rough and shaggy. The latter description applies to those areas which represent a plane passing through the spongy layer of the decidua. But, ordinarily, it is only here and there that this part is torn through. (The surface is also shaggy when, as not infrequently happens, the ends of the villi are exposed, no decidual tissue having been removed).

An exact idea of the surface can best be obtained by placing the placenta in a basin of water and examining it with a hand-

lens. The distinction between the shaggy and smooth portions can thus best be made out.

The fetal surface is covered with the amnion, which is smooth and shining. Through it can be seen the chorionic membrane, from the lower surface of which the villi extend. It has a mottled appearance, usually a mixture of purple, gray and yellow areas. These vary greatly in size, ordinarily having the diameter of a pin-head, pea or bean. In some cases the yellow areas are of considerably larger size.

The amnion may easily be stripped from the surface as far as the insertion of the cord.

The umbilical cord enters this surface of the placenta usually near the center. It may, however, be inserted at any point between the center and the margin. In some cases the cord is inserted into the membranes—the velamentous insertion.

From the cord the branches of the umbilical vein and arteries spread in the superficial part of the chorion, under the amnion, to all parts of the placenta, being very distinctly recognized. The veins are beneath the level of the arteries, and are larger in caliber. There are no anastomoses between the branches of either of these sets of vessels away from the cord. Often the two arteries are connected by a short branch about half an inch above the placental end of the cord.

Most of the vessels can be traced in their various divisions until they disappear as fine branches to supply the villi. Sometimes a large branch disappears abruptly, its ramifications not being visible. In some cases very few of the vessels stand out prominently on the surface. Great variations are noticed as regards the course of the branches. Minot states that the more eccentric the insertion of the cord, the more symmetrically are the vessels distributed; the nearer the center the less their symmetry.

Occasionally, remains of the umbilical duct and vesicle may be noticed under the amnion close to the cord. The former is a miuute sac, the latter a thread-like stalk. Very rarely, these

may be accompanied with omphalo-mesenteric vessels which have been persistent.

At the edge of the placenta the amnion, chorion and decidual layer extend outward as the so-called membranes.

Occasionally, the place of transition is not the edge of the placenta, but a ring around the fetal surface of the organ, internal to the edge.

A good idea of the general plan of the placenta may be obtained from the study of transverse sections across it. On the fetal side are the amniotic and chorionic membranes. On the maternal side is a very thin layer of decidual tissue (absent in places). These meet and are in close apposition at the placental edge; here the decidual layer may often spread for a short distance on the under surface of the chorionic membrane.

Between the decidual and the chorionic layers, there is thus a large area forming the main thickness of the placenta. This area is a space which is almost entirely occupied with projections of the chorion—the so-called villus stems and villi of various sizes, shapes and ages. Many of these are attached to the decidual layer; the great majority of the small villi, however, hang free like the branches of a tree. Surrounding the villi is maternal blood, which gives the dark red color to the placenta. Ordinarily, the intervals between the villi in which the maternal blood is found, are termed *intervillous* spaces, but it must be clearly understood that these spaces are in free communication. In the angle at the edge of the placenta very few villi may exist in some parts. This area, filled mainly with maternal blood has been termed the *circular sinus.* No special name should be given to it, however. It never extends as a distinct sinus around the placenta but is interrupted at irregular intervals by a well-marked development of villi.

Besides the villus-stems and villi, sections of buds and irregular masses of syncytium, growing from the chorionic membrane and villi, are noticed. In many parts, where the free ends have been divided, the appearance is presented of the masses lying

free in the maternal blood. Here and there, several villi closely pressed together are cut across. Some of these are imbedded in fibrin, others are not. These are different forms of the *Zell-knoten* which I have already described. Portions of the fibrin are also found on the surface of a number of villi. Beside these structures are noticed elevations of the decidual layer forming the maternal surface. They are directed perpendicularly or obliquely toward the fetal surface of the placenta. These are generally termed decidual septa. They are very short for the most part. It is rare to find one extending into the intervillous space for any considerable distance. Sometimes, near the edge of the placenta, they may nearly reach the chorionic membrane.

Villi are attached to them, as well as to the general surface of the decidua. Leopold, and others, consider these as of great structural importance, and suppose that fixation-villi are chiefly attached to them. I can not support this view. They are very variable, and in many specimens very poorly developed, and have no special significance in relation to the attachment of villi.

Often sections across their free ends may be noticed, giving the appearance of portions of decidual tissue lying free in the maternal blood of the intervillous spaces.

Occasionally, one of these may be surrounded with a number of villi and, sometimes, a quantity of fibrin. Such masses form another variety of *Zell-knoten*.

The quantity of maternal blood in the intervillous spaces varies greatly. Where it is small the villi are closely massed together.

Of all the tissues above noted, the fetal elements form by far the greatest portion.

This can be beautifully demonstrated if the chorionic vessels be injected with a carmine gelatin solution through the umbilical arteries, and if, afterward, the decidual layer be carefully removed by dissection and the maternal blood washed out of the intervillous spaces. When the mass is placed in water, the thickness of the

placenta is seen to consist of a beautiful frondose arrangement of the injected villi.

In such a preparation the fetal vessels may be distinctly traced. The large veins and arteries ramify in the chorionic membrane, the latter being more branched than the former. They dip down into the villus-stems, dividing mainly dichotomously and extending into their various branches. In the smallest villous twigs only capillaries are found. In short ones there is usually only a single loop; in larger ones a tortuous number of loops, which usually anastomose.

I have already pointed out that the vessels vary in size in different specimens. Ordinarily, the capillaries are small, but they may sometimes be dilated, allowing six or more blood-corpuscles to lie side by side. Occasionally a capillary may be narrow at one point and wide at another.

PLACENTAL INFARCTS.—Very frequently the placenta presents areas of various sizes, shapes and colors, which are generally termed infarcts. Whitridge Williams has recently classified these as follows:

1. Small, whitish or yellowish fibrous-like areas, a few millimetres in thickness, sharply marked off from the surrounding placental tissue.

2. Wedge-shaped or irregularly rounded dull-white areas, of a striated fibrinous appearance.

3. Large portions of placenta showing this change.

4. A yellowish-white rim, varying in width and thickness, extending around the margin of the placenta on the fetal side under the amnion forming a complete or partial ring. (This condition is often termed *"placenta marginata."*)

In some cases this ring is situated some distance internal to the edge.

5. Rarely a pinkish or brick-dust colored mass, of small or large size, found mainly near the maternal surface but sometimes occupying the whole thickness of placenta. These are known as "red infarcts."

6. Very rarely there are scattered through the placenta red or black areas, of various sizes, consisting of blood surrounded by a fibrous-like substance. These are termed by some "red infarcts," by others "apoplexies." Pinard has named the appearance *"placenta truffé."*

Williams points out that these are quite distinct in nature from the above-mentioned red infarcts.

Very many views have been advanced as to the nature of these infarcts. Williams has fully tabulated them, but it is beyond the scope of this work to refer to them in detail. It is here only necessary to consider their relationship to the changes normally found in placental growth and development. Do they occur in healthy conditions or are they an indication of maternal or fetal disease? In the present state of our knowledge it is impossible to answer this question accurately.

Williams noticed infarcts measuring at least 1 cm. in diameter in 315 out of 500 placentæ. Smaller ones, many just visible to the naked eye, were observed in the great majority of placentæ, while microscopic examination revealed early stages of infarct formation in every full-time placenta examined by him.

He regards this condition in a moderate degree of development, as not pathological and exerting no influence upon mother or fetus. It is to be regarded as a sign of senility of the placenta (first suggested by Druitt years ago) analogous to the changes which take place in the villi of the chorion læve in early pregnancy.

My own observations are in harmony with those of Williams, not only as regards the frequency and significance of infarcts but as regards their method of formation.

The chief cause of the process is the thickening of the intima in vessels of various villi, especially of the medium-sized ones. Of less importance in diminishing the lumen of the vessels is thickening of connective tissue around them. These vascular changes, already fully described by me have been noted by a number of previous observers, the most prominent of whom was Ackermann.

The first result of obliteration of the lumen according to Williams is coagulation necrosis beneath the syncytium, with subsequent formation of canalized fibrin.

In my description of full-term villi I have pointed out the frequency of fibrinous material on the surface of the villi, with remains of the syncytial layer external to it, or in some parts none whatever.

This fibrin probably results from changes in the Langhans layer of epithelial cells and the underlying stroma. That the Langhans cells do largely undergo this transformation, normally, as has been mainly demonstrated by Nitabuch and Eberhardt, my sections clearly show.

The syncytium may undergo the same change but always later, as is best demonstrated in the formation of the infarct. Its preservation is probably due to its contact with the maternal blood, from which it may be nourished. As Peters has pointed out, the syncytial layer acts as a kind of a endothelium for the intervillous blood, serving an important function in transmitting necessary elements to the fetal blood-stream. It also undoubtedly tends to prevent coagulation, as Peters suggested. When, therefore, the syncytium becomes largely altered in any area, the blood tends to coagulate there.

In this way, then, the contribution of the maternal blood to the infarct is brought about.

Finally, when several villi are massed together by a fibrinous mass, their entire stroma gradually undergoes a fibrinous degeneration, so that in well-advanced conditions their outlines are often scarcely to be recognized.

Occasionally, infarcts are found, in which along with the villi and fibrin, decidual tissue is found. No doubt, in some cases large cells have been described as decidual, which were those of the Langhans layer, not degenerated; but there can be no doubt that decidual tissue may sometimes form part of these infarct-masses. The appearance is produced when the section divides an elevation of the serotina to which are attached villi in which

the fibrinous changes have progressed. Sometimes, in these, groups of the Langhans cells may also be seen, for I have already demonstrated the frequency with which these cells are proliferated at the ends of the attachment of villi to the decidua, and the variations found in their disappearance as pregnancy advances.

In some cases the infarct-masses consist only of degenerating villi bound together without any blood-coagulation around them. These have been recently termed by Eden as "non-fibrinous infarcts," but Kastschenko first described this matting together of villi.

The red infarct consists of degenerating villi around which the blood has clotted, not gradually, but rapidly, fibrin-formation being, therefore, not much advanced.

Infarct formation is most marked in women with albuminuria. It is found in connection with syphilis and other diseased conditions of the mother, but we can not speak with any accuracy concerning the relationship.

CHAPTER X.

PHYLOGENY OF THE PLACENTA.

In studying the phylogenetic relationships of the human placenta, our investigations need not go beyond the orders of Mammalia. Yet it is of interest to note that, in the non-mammalians, we meet with the first indications of the connection between fetus and uterus, which reaches its most highly specialized development in the various mammalian orders.

Among the Invertebrata, in *Peripatus* found in the Island of Trinidad, a stalk of fetal epiblast extends from the fetus to the uterine wall, where it expands into a disc. This structure has been termed by Kennel, of Würzburg, a placenta. It is non-vascular and the point of attachment to the fetus is not a fixed one, being sometimes the dorsal, sometimes the ventral surface. The accuracy of Kennel's description has, however, been called in question by some competent observers.

In the non-mammalian vertebrata several instances are found of a placenta-like connection with the uterine wall, developed in the yolk-sac. One of the best marked is that of *Mustelus lævis* (Aristotle's dog-fish), first described by Johannes Müller. A somewhat similar arrangement is found in another Elasmobranch, *Charcharias*. Among the Teleostean or bony fishes, *Anableps* shows a development of villi in the yolk-sac attached to the uterine wall.

Above the fishes, among the Sauropsida, in which the allantois is first found, no such union between the fetus and mother exists. Yet among the Lacertilia, the yolk-sac absorbs nourishment from the uterine wall, though separated from it by a porous and rudimentary egg-shell.

Among the Mammalia, most of the orders are found to have

a placenta. In the Monotremata, the young are laid in eggs which develop outside the body.

In the Marsupalia there is a very short gestation period, and during this time the yolk-sac enters into relation with the chorion, forming villi, through which nourishment is received from the uterine wall. In this order the allantoic vessels do not reach the chorion, as the allantois is a rudimentary structure (Perameles is an exception, the allantoic vessels being functional).

In the ordinary classification of the orders as regards placentation, the Marsupalia are not classed with Eutheria, Monodelphia or Placentalia, since these are meant to include only those in which there is a permanent placenta vascularized by allantoic vessels. Ten orders have this characteristic, viz., Edenta, Ungulata, Carnivora, Sirenia, Cetacea, Rodentia, Insectivora, Cheiroptera, Lemuroidea, Anthropoidea.

Of these there are three, in which besides the permanent placenta supplied by allantoic vessels, there is a preliminary yolk-sac placenta supplied by the vitelline vessels. These are Rodentia, Insectivora, Cheiroptera.

Many variations are found as regards the relationship of the vitelline to the permanent placenta in these orders, but it is impossible to speak with accuracy until more extensive studies have been made. Probably, several instances will be found in which there is no vitelline placenta at all. Hubrecht has, for example, discovered that, in *Sorex,* one of the Insectivora, while there is an omphaloidean trophoblastic development, there is no further formation of villi, so that a true vitelline placenta can not be said to exist.

Göhre also states that *Pteropus edulis,* among the Cheiroptera, has no vitelline placenta.

Among the other seven orders sufficient investigations have not been made to enable us to speak with accuracy regarding the rôle played by the yolk-sac. So far as is known, this structure, in the great majority of cases, does not form any primitive placental arrangement. Very often it atrophies at an early period

and disappears; in some instances it remains distinct throughout pregnancy. In many mammals the yolk-sac never has any mesodermic covering and consequently is not vascularized. When vitelline vessels exist they are early obliterated, but in some cases may persist. Yet it is possible that among these orders, the occurrence of a temporary vitelline placenta may be found to exist more frequently than is now believed.

I have been careful to avoid the use of the term "allantoic placenta," so widely employed in describing the permanent mammalian organ. The old view that the human placenta is a development of the allantois can no longer be entertained. Yet it is still widely taught and believed by many, notwithstanding the corroboration of His' discoveries by several workers in recent years.

This observer pointed out that the embryo is never separated from the chorion, but is continuous with it by a prolongation of its posterior extremity, termed the *"bauchstiel."* In this the allantois lies as a small tube, a prolongation of the gut, which extends along the anterior wall of the pelvic region. The umbilical arteries derived from the iliacs grow outward in the mesoblastic covering of the allantois and *extend much farther than the hypoblastic allantoic canal,* reaching the mesoblast of the chorion, in which they spread. It was long held that the allantois formed the mesoblast of the chorionic membrane. This is not the case. The latter has a mesoblastic layer before the umbilical arteries reach it. As Minot expresses it, "the mesoderm of the chorion is proper to it as much as to any part of the somatopleure, the mesoderm thereof." It may, then, be confidently stated that the permanent placenta is an organ of the chorion and not of the yolk-sac or allantois, not only in the human subject but probably in the great majority of mammalians.

Hubrecht thinks that the term "chorion" should be limited to the description of the human ovum, in order to avoid the misunderstandings which may have arisen in the past from the indis-

criminate use of the word. He proposes to employ the following terminology.

The outer epiblastic layer of the blastocyst which enters into relation with the maternal tissue he designates the *trophoblast*. This layer, plus the thin layer of early non-vascular mesoblast, he names the *diplotrophoblast*. The portion of the diplotrophoblast to which the yolk-sac with its *area vasculosa* adheres, is termed *omphaloidean diplotrophoblast;* that to which the allantoic vessels are related, the *allantoidean diplotrophoblast*. He gives the following table showing the different terms used by various authors:

TABULAR COMPARISON OF THE NOMENCLATURE OF CERTAIN FETAL AND MATERNAL STRUCTURES THAT TAKE PART IN THE PLACENTATION OF THE MAMMALIA.

Hubrecht.	Frommel.	van Beneden.	Fleischmann.	Selenka.	Bonnet.	Balfour.	von Baer.
Trophoblast....	Exochorion primitivum + decidual schicht.......	Cytoblast and plasmodiblast (horseshoe-shaped proliferation).......	Chorion..	Exochorion Träger p. p. Deckzellenschicht (Rauber's and Reichert's cells	....	Epiblast of non-embryonic part of blastodermic vesicle.....	Exochorion
Diplotrophoblast.	Membrana chorii + Exochorion primitivum p. p......	Séreuse de von Baer.	......	Seröse Hülle resp. Chorion.	Amniogenes chorion Primitive chorion	Subzonal membrane	Seröse Hülle
Allantoidean Diplotrophoblast..	....	....	Allanto-chorion	Allantois chorion, Euchorion, Placentar chorion.	Allantois chorion, Gefässchorion....	True chorion..	Chorion.
Omphaloidean Diplotrophoblast	....	....	Omphalo-chorion	Dottersackchorion, Pseudochorion.........	....	....	......
Trophospongia..	Gefässschicht. Epithellager innerhalb der (decidualen) Faserschicht....	....	......	....	....	....	......
Wall of blastocyst (indpendently of histological constitution)....	....	....	......	Chorion...........	....	....	....

To the above list may be added Kölliker's "Ektodermawulst" and Duval's "formation ectoplacentaire" as describing the trophoblast of Hubrecht.

It has been stated by various authors, *e. g.*, Colomiatti, Weigert, Labougle and Regnier, that, in the human female, a permanent placenta may occasionally be developed from the yolk-sac.

Ballantyne has recently elaborated this speculation in an interesting paper. It is based on the study of sympodial monsters. In these there is a common absence of allantoic derivatives (bladder, urachus, hypogastric arteries), and of the lower end of the large intestine (from which the allantois arises); there is a common presence of vitelline derivatives (omphalo-mesenteric artery, vitelline duct). The villi of the placenta which is present is supplied by an artery which arises from the aorta and is probably the persistent vitelline artery. The hypogastric arteries are usually absent, but if they exist they never enter the umbilical cord. From these facts, Ballantyne concludes that the placenta is vitelline. This conclusion is quite unwarranted if it implies a villous formation of the umbilical vesicle like that which occurs in some of the lower mammals. It is, however, entirely warrantable if it is taken in the sense that the vascular supply of the placenta probably corresponds to the original vitelline vessels.

If, in normal cases, the allantoic tissues are not necessary to the placental structure, which is an organ of the chorion, neither is the yolk-sac necessary. In the former, the fetal blood is carried to the villi by the hypogastric arteries which happen to supply the allantoic tract as well.

When this supply is wanting, as the result of an embryonic malformation, *e. g.*, sympodial fetus, the omphalo-mesenteric artery is able to extend into the mesoblast of the chorion, supplying the villi.

One thing is taught clearly by such monstrosities, viz., that a well-formed placenta may be developed without any participation whatever of the allantois.

The phylogeny of the human placenta can not at the present time be fully detailed, because of the comparative sparseness of full and accurate descriptions of placentation in the various

genera and species of the mammalian orders. Moreover, it is impossible to homologate the different accounts which we do possess, because of the many conflicting opinions existing concerning the interpretations of appearances found on histological examination.

For many years views have been accepted regarding both the ontogeny and phylogeny of the placenta, which were based upon wholly inadequate data. The ontogenetic errors I have fully detailed in the previous part of this work.

As regards the phylogenetic relationships of the placenta, there has been a growing tendency to discard the older views, mainly as a result of investigations of recent workers, of whom Professor Hubrecht, of Utrecht, deserves most prominent mention.

For many years the teaching of Sir William Turner, of Edinburgh, has been widely accepted, viz., that in the mammalia the lowest form of placentation is found in the pig, and that successively higher forms are found in the Ruminants, Carnivora and Primates, the highest occurring in man.

At the present time, in the light of recent investigations made by careful modern laboratory methods, it is difficult any longer to entertain this view. Hubrecht has urged the intrinsic improbability of the idea that the various stages of the evolution of the placenta should be found in orders so divergent and specialized as the Ungulata, Carnivora and Primates, which are not related in a direct line.

The first indication of the direction taken by those modern researches which have helped to discredit Turner's views, was given by Huxley, who taught for many years that the Insectivora hold an important central position among the higher Mammalia, and are to be regarded as among the more primitive monodelphian mammals.

Paleontological investigations conducted by other workers have amply corroborated Huxley's statement.

Huxley pointed out that, while the Insectivora present a great diversity of organization, having relationships with various monodelphian orders, the common hedgehog *(Erinaceus Euro-*

pœus) seems to occupy a central position. It was this statement which gave the impetus to Hubrecht's investigations into the placentation of this central form, the results of which were published in 1889. Speculating, in his monograph, as to what might be found in the early stages of human placentation, Hubrecht made several predictions which have been fully realized by recently described early human pregnancies, especially by Peters' specimen. In the latter, the proliferation of the epiblastic covering around the entire blastocyst is the homologue of that proliferation in the hedgehog, termed by Hubrecht, the trophoblast. In the case of both the formation of lacunæ occurs, into which the maternal blood finds its way. The trophoblast may thus be compared to a sponge. As the lacunæ enlarge the trabeculæ between them get smaller, and represent the earliest villous connection between ovum and decidua. Later, these epiblastic strands are penetrated by fetal mesoblast in which blood-vessels are developed, giving rise to the first representatives of the villi which are found in more advanced placental stages.

Only, in the hedgehog, the branching of the villi is never as elaborate as in man.

In both, the trophoblast has a phagocytic action on the maternal tissues.

In both, in the maternal tissue in which the early blastocyst becomes imbedded, there is a marked edema, and a small quantity of blood exudes against the ovum.

In both, the maternal epithelium plays a negative part, tending to degenerate and disappear, being undoubtedly partly absorbed by the trophoblast. Degeneration also characterizes the glandular structures.

In the hedgehog the ovum at first becomes attached to a depression on the mucosal surface. It soon gets covered by the closure of the maternal tissue over it, thus forming the homologue of the human decidua reflexa. In man, Peters' specimen demonstrates that the blastocyst burrows into the substance of the compact layer of the mucosa. A difference is also noted as regards

the mucosal vessels. In man, the vessels become markedly dilated near the ovum, and some degree of new formation is noted. In the hedgehog, besides the dilatation, marked proliferation of the endothelium of many vessels occurs, forming a distinct layer, the tropho-spongia which lies next the trophoblast layer.

Other differences exist, but need not be referred to in particular. A most important distinction is the part played by the yolk-sac in the hedgehog's placentation, which is entirely wanting in man.

Peters' account of the establishment of the earliest stage in the formation of the intervillous circulation in the human subject, disposes completely of the older views of Turner, Balfour, Ercolani and others, viz., that the intervillous spaces are derived from maternal capillaries which have become dilated, the villi dipping into them—a conception which naturally was related by them to the condition in the pig where the early blastocyst develops villi which fit into vascular crypts in the maternal mucosa, from which they easily retract at birth. Turner also believes that the villi, thus dipping into maternal sinuses, received an investment of maternal tissue. This has been abundantly disproved. and there can be no longer any doubt that the epithelium found on the villi of the human placenta is of fetal origin.

Kölliker and Langhans regarded the intervillous spaces as corresponding to that part of the uterine lumen which lay between the chorion and the mucosal surface, Langhans giving the name *placentarraum* to the space. Peters' specimen proves that this view is incorrect, the spaces being originally due to lacunar formation in the fetal trophoblast, the whole blastocyst having burrowed beneath the surface of the mucosa.

The Cheiroptera show close analogies to the Insectivora and man in stages of placentation, as regards the trophoblast, lacunar formation, and relation to maternal blood, though several variations in details exist.

The Rodentia also have many features in common. Among the Lemuridæ or Prosimiæ, Hubrecht has found that in *Tarsius*

spectrum there is no preliminary omphaloidean placental development. The fully-formed placenta is discoid, whereas, in the past it has been held that the placentation of the Lemuridæ was diffuse in all cases. In the early stages there is trophoblastic development, lacunar formation and several other changes similar to those found in man.

With regard to monkeys there are very few data concerning the early stages of placentation. Selenka's work is greatly marred by his misinterpretations. His sections show close resemblances to the conditions found in man, but he wrongly regards the fetal epiblast as derived from uterine glandular and surface epithelium and tries to show that the fetal villi dip into the glands.

Older specimens have been described, chiefly by Turner, Waldeyer and Hart. The appearances presented on microscopic examination resemble very closely those found in the human subject. Waldeyer and Hart have both noted the well-formed outer layer of the villi extending over the serotinal surface; the former in *Innus Nemestrinus,* the latter in *Macacus Rhesus.* It seems to be better preserved than in specimens of human pregnancy at corresponding periods. Waldeyer has, however, made the mistake of regarding this layer as a prolongation of endothelium from maternal vessels.

One important point to be noted regarding some of the lower monkeys is the occurrence of a bi-lobed placenta, one lobe being situated on the anterior wall and the other on the posterior wall of the uterus.

The discoid shape of the human placenta is explained by the conditions which exist in early embryonic life. In the great majority of cases the chorionic villi in relation to the reflexa gradually degenerate and become functionless. As I have pointed out, this is probably due to the thinness, imperfect vascularization and degeneration of the reflexa. The rest of the chorion continuing its development, in relation to the serotina, necessarily has the form usually found.

Variations in the shape of the placenta are due to differences in the extent of villous development and degeneration in early life. The explanation of these differences is not clear. Possibly they are most frequently due to abnormal development of the reflexal chorion next the serotina. I have pointed out that there may be occasionally a very extensive formation of a reflexal placenta associated with unusual development of the reflexa. Peters' description of the implantation of the blastocyst makes it easy to understand why there may be variations in the development of the reflexa in different cases. If, for example, the blastocyst burrowed unusually deeply a thick reflexa might result. In the hedgehog the discoid placenta is that part developed in relation to the allantoidean circulation. It remains after the degeneration of the omphaloidean villi which early developed in relation to the reflexa.

PLATE I.

FIG. 1.—DIAGRAMMATIC REPRESENTATION OF THE RELATIONSHIP OF OVUM TO DECIDUA AT A STAGE CORRESPONDING TO THAT DESCRIBED BY H. PETERS, VIZ., THE SECOND PART OF THE FIRST WEEK.

a, fetal mesoblast, showing indications of beginning extension outward into trophoblast; *b*, trophoblast; *c*, lacuna in trophoblast, with which a maternal blood-sinus communicates; *d*, syncytial transformation of trophoblast next lacuna; *e*, decidua; *f*, maternal blood-sinus; *g*, endothelium lining maternal sinus.

FIG. 2.—DIAGRAMMATIC REPRESENTATION OF A STAGE A FEW DAYS FURTHER ADVANCED THAN THAT DESCRIBED BY H. PETERS.

a, fetal mesoblast, showing extension outward into stalks of trophoblast—the earliest villus-stems; *b*, trophoblast; *c*, intervillous space formed by the enlargement of lacuna in early trophoblast; *d*, syncytium; *e*, decidua; *f*, maternal blood-sinus opening into intervillous space; *g*, endothelium lining maternal blood-sinus.

FIG. 3.—DIAGRAMMATIC REPRESENTATION OF A STAGE A FEW MONTHS FURTHER ADVANCED, WHEN THE PLACENTA IS WELL-DEFINED.

a, fetal mesoblast; *b*, Langhans' layer, or remains of early trophoblast; *c*, intervillous space; *d*, syncytium; *e*, decidua; *f*, maternal blood-sinus; *g*, endothelium of maternal sinus; *h*, epiblastic covering of umbilical cord; *i*, amniotic epiblast; *j*, umbilical vein; *k*, umbilical artery; *l*, amniotic mesoblast; *m*, slight extension of decidua on under surface of chorion at edge of placenta; *n*, large villus-stem.

PLATE I.

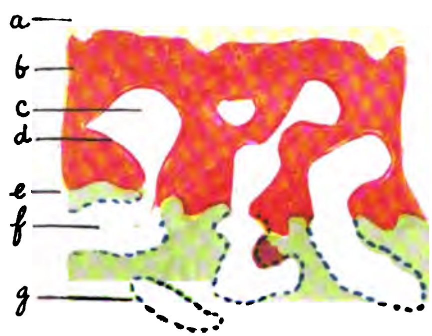

FIG. I.

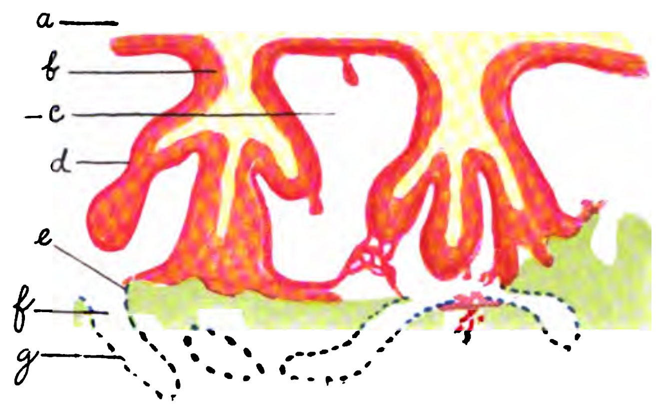

FIG. II.

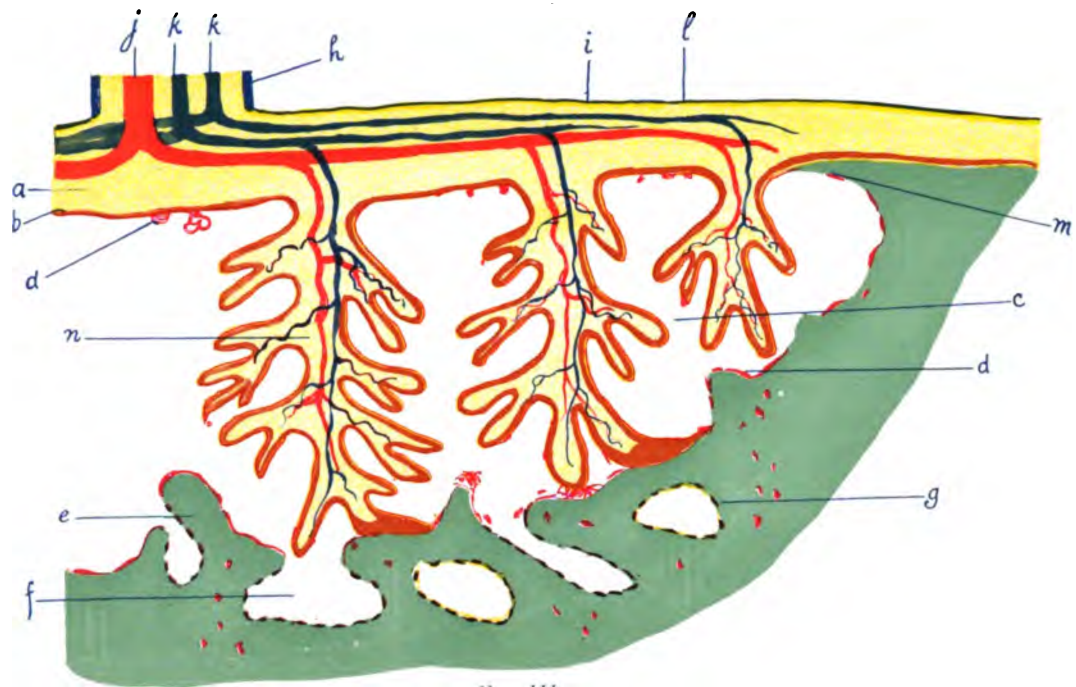

FIG. III.

BIBLIOGRAPHY.

Abel: Anat. d. Eileiterschwangerschaft, etc. Arch. f. Gynaek, Bd. xxxix.

Ackermann: Zur normalen u. pathologischen Anat. der menschl. Placenta. Beiträge z. wissenschäftlichen Medicin, Bd. i. S. 583. (Festschrift für Virchow). Der weisse Infarct d. Placenta. Virchow's Arch. Bd. xcvi, 1884.

Ahlfeld: Beschreibung eines sehr kleinen menschl. Eies. Arch. f. Gyn., Bd. xiii, S. 241.

Ein neuer Beitrag z. Lehre d. Placenta prævia. Centralblatt f. Gyn., 1892, Nr. 12.

Die Entstehung der Placenta prævia. Zeitschr. f. Geb. u. Gyn., 1891. Bd. xxi, S. 291. Berichte und Arbeiten aus d. geburtshülflichen Klinik zu Giessen. Leipzig. 1883. Discussion über Placenta prævia. Verhandlung d. deutschen gyn. Gesellsch. Bd. vii, 1897.

Ballantyne: The Occurrence of a non-Allantoic or Vitelline Placenta in the Human Subject. Obst. Trans. Edinburgh, vol. xxiii.

Barbour: The Anat. and Relat. of the Uterus, etc. Obstet. Trans., Edinburgh, 1884. The Anat. of Labour, Edin., 1889.

Bayer: Ueber Placenta prævia. Verhandl. d. deutschen Gesellsch f. Gyn. 1886, Bd. i, und 1897, Bd. vii.

Beigel and Löwe: Beschreibung eines menschlichen Eies aus der 2. bis 3. Woche d. Schwangerschaft. Arch. f. Gyn., Bd. xii.

Van Beneden: De la fixation du blastocyte à la muqueuse uterine chez le murin. Bullet. de l'Académ. royale Belgique, Jan., 1888.

De la formation et de la constitution du placenta chez le murin. Bullet. de l'Académ. royale Belgique, Fevr., 1888.

Letter to Duval, Comptes Rendus de la Société royale de Belgique, 1888.

Van Beneden et Julin: Recherches sur la formation des annexes fœtal, chez les mammifères. Archiv. de Biol., 1884.

Bischoff: Entwickelungsgeschichte der Saügethiere und des Menschen., 1842. Entwicklungsgeschichte d. Meerschweinchens. Giessen, 1852. Entwickelungsgeschichte d. Kaninchens. Braunschweig, 1842.

Blacher: Noch ein Beitrag zum Baue d. menschlichen Eihüllen. Arch. f. Gyn., Bd. xiv.

Bloch: Ueber den Bau d. menschl. Placenta. Beiträge zur patholog. Anat. u. zur allgemein. Pathologie, Ziegler. Bd. iv, Heft 5.

Bonnet: Beiträge zur Embryologie der Wiederkauer. Arch. f. Anat. und Physiol. Anat. Abtheil., 1889.

Bumm: Ueber Utero-Placentargefässe. Verhandl. d. deutsch. Gesellsch. fur Gyn., III Congress. Leipzig, 1890. Ueber die Entwickelung d. menschl. Placenta. Sitzungsber. d. physical. medicin. Gesellschaft zu Würzburg, 1891. Ueber die Entwickelung d. mutterlichen Blutkreislaufes in d. menschl. Placenta. Arch. f. Gyn. Bd. xliii, Heft 2. Zur Kenntniss d. Utero-Placentargefässe. Arch. f. Gyn. Bd. xxxvii.

Breus: Ein Ei aus d. zweiten Woche d. Gravidität. Wien. med. Wochenschr., 1887.

Coste: Embryogenie comparée. Paris, 1837.

Cruveilhier: Vide Traité complet de l'Art des Accouchments, par Dubois et Pagot. T. i.

Duncan Matthews: Researches in Obstetrics. Edinburgh, 1868.

Duval: Le placenta des Carnassiers. Journal de l'Anat. et de la Physiolog., 1893. Comptes rendus de la Société de Biologie, S. 1059. Le Placenta des Rongeurs. Journal de l'Anat. et de la Physiolog., 1889-1892. Etude sur l'Embryologie des Chéiroptéres. Journal de l'Anat. et de la Physiolog., 1895-1897. Comptes rendus de la Société de Biologie, 1887-1888.

Eberhard: Ueber gerinnungen in d. placenta. Dissertation. Bern, 1891.

Eckhardt: Beiträge zur Anat. d. menschl. Placenta. Zeitschr. fur Gebürtsh. u. Gyn. Bd. xix, Heft. 2.

Eden: A Study of the Human Placenta. Journ. of Path. and Bact., 1896.

Ercolani: Sul processo formativo della porzione glandulare o. materna della placenta. Memorie della Academia di szience di Bologna, ser. 2, da tomo iv, 1869. Sull unita del tipo anatomico della placenta. ibidem ser. da tomo vii, 1876. Nuove ricerche sulla placenta nei pesci curtilaginosi e nei mammiferi, ibidem, ser. 3, a tomo x, 1879.

Farre: Todd's cyclop. Anat., 1858.

Fleischmann· Ueber die erste Anlage d. Placenta bei Raubthieren. Sitzungsber. d. physikalisch-medic. Societät zu Erlangen, 1887. Heft. 19. Embryologische Untersuchungen. 1. Heft. Untersuch. über einheimische Raubthiere. Wiesbaden, 1889. Entwickelung und Structur d. Placenta bei Raubthieren. Sitzungsber. d. preuss. Acad. d. Wissenschaften in Berlin, 1891. Embryologische Untersuchungen. 3. Heft. Die Morphologie d. Placenta bei Nagern und Raubthieren. Weisbaden, 1893.

Fränkel, Eugen: Untersuch. u d. Decidua Circumflexa, etc. Arch. f. Gyn., Bd. xlvii.

Fränkel, L.: Vergleichende Untersuchung. d. Uterus—und Chorionepitheis. Arch. f. Gyn. Bd. lv, Heft. 2.

Verhandl. d. deutsch. Gesellsch. f. Gyn., Bd. vii, 1897. Das Uterus—und Chorionepithel beim Menschen u. einigen Säugern. Naturforsch. versamml. zu Braunschweig. Verhandl. ii.

Friedländer: Physiol. anatom. Untersuch. u. d. Uterus, Leipzig, 1870. Uber d. Innenflache d. Uterus p. p. Arch. f Gynaek., Bd. ix.

Frommel: Ueber d. Entwickelung d. Placenta von Myotus Murinus. Wiesbaden, 1888. Beitrag zur Frage d. Wachsthumsrichtung d. Placenta. Zeitschr. f Geburtsh. u. Gyn.,'Bd. xxxvi, Heft. 3.

Gaiser: Zur Entwickelung d. Placenta. In Leopold's Uterus und Kind. Leipzig, 1897.

Goodsir, Structure of the Human Placenta. Anat. and Path. Observations, Edinburgh, 1845.

Göhre: Ueber Entwickelung von Pteropus edulis, in Selenka's Studien über die Entwickelungsgeschichte. Bd. v. Wiesbaden.

Gottschalk: Beiträge zur Entwickelungsgeschichte d. menschl. Placenta. Arch. f. Gyn., Bd., xxxvii. Zur Entwickelungsgeschichte d. menschl. Placenta. Verhandl. d. x. international. medicin. Congress. Berlin, 1890. Bd. iii, Abth. 8. Weitere Studien über d. Entwickelung d. menschlichen Placenta. Arch. f. Gyn., Bd. xl. Verhandlg. d. Deutschen Gesellsch f. Gyn., Bd. vii. (Congr. zu Leipzig), 1897.

Hahn: Ein Stadium d. Placentaentwickelung. Zeitschr. f. Geburtsh. u. Gyn., 1896., Bd. xxxiv.

Hart: The Sectional Anatomy of Macacus Rhesus. Selected papers, 1893.

Hart and Gulland: On the structure of the human placenta, with special reference to the origin of the Decidua Reflexa. Reports from the Laboratory of the Royal College of Physicians. Edinburg. 1892.

Heape: The development of the Mole (Talpa europea), the formation of the germinal layers and early development of the medullary groove and notochord. Quarterly Journ. of Microscop. Science, 1883, vol. xxiii,, new ser.

Heinricius: Ueber d. Entwickelung u. Structur d. Placenta beim Hunde. Arch. f. mikros. Anat., Bd. xxxiii.

Heinz: Untersuchungen über d. Bau und d. Entwickelung d. menschl. Placenta. Inaug-Dissert. Breslau, 1888.

Hennig: Studien über d. Bau. d. mensch. Placenta, etc. Leipzig, 1872.

Hensen: Beobachtungen über d. Befruchtung u. Entwickelung d. Meerschweinchens und Kaninchens. Zeitschr. f. Anat. und Entwickelungsgeschichte, 1876, Bd. i.

V. Heukelbom Siegenbeck: Ueber d. menschl. Plac. Arch. f. Anat. u. Phys. Anat. Abt., 1898. Verhandl. d. Gesellsch. deutscher Naturforscher u. Aertze. Versamml. su Braunschweig, Th. ii.

Heschl: Researches on the conduct of the Human Uterus after delivery. (Eng. Trans., by McDonnel.) 1853.

His: Anatom. mensch. Embryo, Pt. I, 1880.

Hofmeier (Benckiser): Beiträge z. Anat. d. schwang. u. kreiss. Uterus. Stuttgart, 1887. Ueber Contractionsverhältnisse d. kreissenden Uterus. Zeitschr. f. Geburtsh. und Gyn., Bd. vi. Demonstrationen in d. Gesellsch. f. Geburtsh u. Gyn. zu. Berlin. Centralblatt, Bd. x., Nr. 46, Arch. f. Gyn. xxxii. Die menschliche Placenta, Weisbaden, 1890. Zur Entwickelung d. Placenta prævia, Zeitschr. f. Geburtsh. u. Gyn., Bd. xxix. Zur Entwickelung d. Placenta prævia, Centralbl. f. Gyn., 1895, Bd. xix. Zur Anatomie der Placenta prævia. Verhandlg. d. deutschen Gesellsch. f. Gyn., Bd. vi, 1895, S. 621. Beiträge zur Anat. u. Entwickelung d. menschl. Placenta. Zeitsch. f. Geburtsh. u. Gyn., Bd. xxxv, Heft. 3, S. 414. Referat über Placenta prævia. Verhandl. d. deutsch. Gesellsch. f. Gyn., Bd. vii, 1897. Centralb. f. Gyn., Nr. 23, 1895.

Hubrecht: The Placentation of Erinaceus Europæus, etc. Quart. Journ. of Micros. Sc., 1889. The Placentation of the Shrew. Ibid. Vol. xxxv, part 4. Spolia Nemoris. Vol. xxxvi, part 1. Die Phylogenese d. Amnions und d. Bedeutung d. Trophoblastes. Verhandl. d. konik. Acad. v. Wettensch te Amsterdam, D. iv, No. 5, 1895. Die Keimblase von Tarsius. Festschrift fur Gegenbauer., Leipzig, 1896. Ueber die Rolle des embryonalen Trophoblasts bei d. Placentation. Naturforscherversammlung zu Braunschweig.

Hunter, W.: An Anatom. Descr. of the Human Gravid Uterus, etc. London, 1749.

Huxley: On the application of the Laws of Evolution to the Arrangement of the Mammalia. Proc. Zool. Soc., London, 1880.

Hill, J. P.: The Placentation of Peramales. Quart. Journ. of Micr. Sc. Vol. xl, part 3.

Hollard: Rercherches sur le placenta des rongeurs et en particulier sur celui des lapins. Annales des sciences naturelles, 4 ser., Zoologie Tome, xix.

Jassinsky: Zur Lehre über d. Structur der Placenta. Virchow's Arch., Bd. xl, 1867.

Johannsen: Ueber das Chorionepithel d. Menschen. Monatsschr. f. Geburtsh. u. Gyn., Bd. v, 1897.

Kaltenbach: Zur Pathogenese d. Plac. prævia. Zeitschr. f. Geburtsh. u. Gyn., Bd. xviii.

Kastschenko: Das menschliche Chorionepithel u. dessen Rolle bei d. Histogenese d. Placenta. Arch. f. Anat. und Phys. Anat. Abthlg., 1885.

Keibel: Ein sehr junges menschl. Ei. Arch. f. Anat. und Phys. Anat. Abthlg., 1890. Zur Entwickelungsgeschichte d. menschlichen Placenta. Vorlfg. Mitthlg. Anat. Anzeiger, Centralb. für d. gesammte wissenschaftl. Anat. Amtliches Organ der anat. Gesellsch. 4. Jahrgang, 1899. 17. Studien zur Entwickelungsgeschichte d. Schweines. Morphol. Arbeiten. Herausg. v. G. Schwalbe. Bd. iii, Bd. v, 1893 und 1895.

Keilmann: Der Placentarboden b. d. Decidualen Thieren. Inaugural-Dissertation. Dorpat, 1893. Die Entwickelung. d. Placenta prævia. Zeitschr. f. Geburtsh. u. Gyn., 1895. Bd. xxxiii.

Klein: Zur Anat. d. schwangeren Tube. Zeitschr. f. Geburtsh. u. Gyn., Bd. xx. Makroskopisches Verhalten d. Utero-Placentargefässe in Hofmeier's menschl. Placenta. Weisbaden, 1890. Entwickelung und Rückbildung d. Decidua. Zeitschr. f. Geburtsh. u. Gyn.. Bd. xxii.

Klebs: Zur vergleich. Anatomie d. Placenta. Arch. f. Mikroskopische Anatomie, Bd. xxxvii. Handbuch der pathologischen Anatomie. Berlin, 1873. Verhandlungen d. Gesellsch. f. Geburtsh. in Berlin. Heft. 17, 1865.

Kölliker: Entwickelungsgeschichte, 1884. Die Entwickelung d. Keimblätter d. Kaninchens. Zoolog. Anzeig. Bd. iii, 1880, Nr. 61 u. 62.

Kollmann: Die menschlichen Eier von 6 Millimeter Grosse. Arch. f. Anatomie u. Physiolog. Anat. Abthlg., 1879.

König: Ueber Utero-Placentargefasse, ihr makroskop. und mikroskop. Verhalten. Dissert. Würzburg, 1891.

Kossmann: Zur Histologie d. Chorionzotten. Festschrift f. Leuckart. Leipzig, 1892. Zur Histologie d. Extrauterinschwang. nebst Bemerkungen über

ein sehr jung. mit d. uterin. Decidua gelöstes Ei. Zeitschr. f. Geburtsh. u. Gyn., Bd. xxvii, Heft. 1. Das Syncytium d. menschl. Placenta. Centralbl. f. Gyn., 1893, 44. Studien zur normalen u. patholog. Anat. d. Placenta. Archiv f. Gyn., Bd. lvii, Heft. 1.

Kundrat und Engelmann: Untersuch. über d. Uterusschleimhaut. Stricher's Medic. Jahrbucher., 1873.

Kupffer: Decidua und Ei. d. Menschen am Ende d. ersten Monates. Münch. med. Wochenschrift. 1888, Nr. 31.

Lange: Beitrag z. Histol. d. mensch. Amnion u. d. Nabelstranges. Arch. f. Gyn., 1894.

Langhans: Zur Kenntniss d. mensch. Placenta. Arch. f. Gyn., Bd. i, Heft. 2. Untersuchungen über d. mensch. Placenta. Arch. f. Anat. und Physiol. Anat., Abthlg., 1877.

Laulanié: Sur une nouvelle espèce d' élemént anatomique. La. placentcell. de quelques rongeurs. Comptes rendus de la société de Biologie de Paris, 1885. Sur le processus vaso-formatio qui préside a l'édification de la zone functionelle du placenta maternel dans le cobaye. Comptes rendus de la soc. de Biologie de Paris, 1886.

Leopold: Studien über d. Uterusschleimhaut während d. Menstruation, Schwangerschaft u. Wochenbett. Arch. f. Gyn., Bd. Heft. 1 u. 2. Ueber den bau der Placenta. III Congress d. deutsch. Gyn. Gesellsch., Leipzig, 1890. Uterus und Kind, Leipzig, 1897. Ueber d. Entstehung d. intravillösen Kreislaufes u. über d. Collum uteri wahrend d. Schwangerschaft u. bis zum Beginn d. Geburt. Verhandlg. d. deutsch. Gyn. Gesellsch., Bd. vii, 1897.

Lieberkühn: Ueber die Keimblätter d. Saugethiere. Marburg, 1897.

Strahl: Der grüne Saum d. Hundeplacenta. Arch. f. Anat. u. Physiol. Anatom., Abthlg., 1889.

Lüsebrink: Die erste Entwickelung d. Zotten in d. Hundeplacenta. Anat. Hefte von Merkel u. Bonnet. Bd. i.

Mall: Early human embryo, etc. Johns Hopkins Hospital Bulletin, 1893, No. 36. A human embryo of the second week. Anatomischer Anzeiger, 1893. 8. Jahrgang. Contributions to the science of Medicine, 1900.

Masius: De la génèse du placenta chez le lapin. Arch. de Biolog. T. ix, 1889.

Masquelin et Swaen: Premières phases du developpement du placenta maternal chez le lapin. Bull. de l'Acad. royal Belg., 1879. Arch. de Biologie, 1889.

Mauthner: Ueber d. mütterlichen Kreislauf in d. Kaninschenplacenta mit Rücksicht auf die in d. mensch. Placenta bis jetzt aufgefundenen anatom. Verhältnisse. Akad. d. Wissensch. Wien, Bd. lxvii.

Maximow: Zur Kenntniss d. feineren Baues d. Kaninchenplacenta. Arch. f. mikrosc. Anat. u. Entwickelungsgesch., Bd. li, 1898.

Mayer: Monatsschrift f. Geburtskunde, Bd. xxv.

Merttens: Beiträge zur normal. u. patholog. Anat. d. menschl. Placenta. Zeitschr. f. Geburtsh. u. Gyn., Bd. xxx, Heft. i.

Minot: Embryology, Boston, 1892. Uterus and Embryo. I. Rabbit, II. Man. Journal of Morphology, Vol. xi, 1889. Die Placenta d. Kaninchens. Biolog. Centralb., Bd. x, S. 114. A theory of the structure of the placenta. Anatom. Anzeiger, 1891, S. 125.

Nitabuch: Beiträge zur Kenntniss d. menschl. Placenta. Inaug-Dissert., Bonn, 1887.

Nolf: Etude des modifications de la muqueuse uterine pendant la gestation chez le murin. Arch. de Biologie. T. xiv. Bull. de l'Acad. royale Belgique. T. 38.

Nussbaum: Zur Entwickelungsgeschichte d. Placenta d. Maus (weisse Varietat) Anat. Anzeiger, 1890.

Osborn: The Rise of the mammalia in North America. Studies from the Biological Laboratories of Columbia College, Vol. i, ii.

Patenko: Zur Lehre d .physiol. Thrombose d. Uteringefässe wahrend d. Schwangerschaft. Arch. f. Gyn., xiv.

Pels Leuden: Ueber d. serotinalen Riesenzellen u. ihre Beziehunger zur Regeneration d. epithel. Elemente d. Uterus an d. Placentarstelle. Zeitschr. f. Geburtsh. u. Gyn., Bd. xxxvi, Heft. i.

Peters: Verhandlg. d. deutsch. Gesellsch. f. Gyn., vii, Leipzig, 1897. Verhandl. deutsch. Naturforscherversammlung zu Braunschweig, 1897. Monatsschrift f. Geburtsh. u. Gyn., 1899. Ueber d. Einbettung d. menschl. Eies, etc., 1899.

Priestly: Lectures on the Devel. of the Gravid Uterus, London, 1860.

Rauber: Die erste Entwickelung d. Kaninchens. Sitzungsbericht der Naturf. Gesellsch. zu Leipzig, 1875.

Reichert: Beschreibung einer frühzeit. menschl. Frucht im bläschenförmigen Bildungszustande nebst vergleich. Untersuchungen über d. bläschenförmigen Fruchte d. Säugethiere u. d. menschen. Abhandlungen d. königl. Akad. d. Wissensch., Berlin, 1873.

Reinstein-Mogilowa: Ueber d. Betheiligung d. Zellschicht d. Chorions an d. Bildung d. Serotina u. Reflexa. Virchow's Arch., 1891, Bd. cxxiv, und Dissertation, Bern, 1891.

Rindfleisch: Lehrbuch der patholog. Anat., 1889.

Rohr: Die Beziehungen der mütterlichen Gefässe zu den intravillösen Räumen der reifen Placenta speciell zur Thrombose derselben (weisser Infarct), Inaug-Dissert., Bern, 1889.

Romiti: Sulla struttura della placenta. Rivista clinica ser. 2, da Bologna, 1873. Sulla struttura della placenta umana e più specialmente sulla natura des rivestimente del villo placentale. Att. della R. Academia delle Fisiocritici. Sec. iii, Vol. iii, 1880, Sienna.

C. Ruge: Ueber die menschl. Placentation. Verhandlungen d. deutsch. Gesellsch. f. Gyn., Zeitschr. f. Geburtsh. u. Gyn., Bd. xxxix, Heft. 3. Verhandlungen d. deutschen Gesellschaft f. Geburtsh. und Gyn., 1897, Bd. vii.

Schröder van der Kolk: Waarnemingen over het maaksel van de menschelijke placenta in over haren Bloods-omloop, Verhandlg. van k. Nederlandsche Institut, 1851.

O. Schultze: Grundriss. d. Entwickelungsgeschichte d. Menschen und d. Säugethiere, Leipzig, 1896. Ueber die Embryonalhüllen u. d. Placenta d. Säugethiere u. d. Menschen. Sitzungsbericht d. Würzburger physik.-med. Gesellschaft, 1896.

Schwabe: Eine frühzeitige menschl. Frucht im bläschenförmigen Bildungszustande. Zeitschr. f. Geburtsh. u. Gyn., Bd. iv.

Seiler-Burkhard: Die Gebärmutter u. das Ei d. Menschen in d. ersten Schwangerschaftsmonaten. Dresden, 1832.

Selenka: Studien über Entwickelungsgeschichte d. Thiere. Heft. 1 und 3, Wiesbaden, 1883, 1884, und Heft. 5, Wiesbaden, 1891. Zur Entwickelung d. Placenta d. Menschen. Biolog., Centralbl., 1890, No. 10.

V. Spee: Neue Beobachtungen über sehr frühe Entwickelungsstufen d. menschlichen Eies, Arch. f. Anat. und Physiolog. Anat. Abth., 1896. Vorgänge bei der Bildung der Fruchthöle im Uterus. speciell des Meerschweinchens u. des Menschen. Mitth. d. Ver. Schleswig-holstein'scher Aerzte, 1891. Heft. 12, und Sitzung des physiologischen Vereines zu Kiel, 2. Nov., 1891. Vorgänge bei der Implantation des Meerschcweincheneies in die Uteruswand. Verhandl. d. anat. Gesellsch., April, 1896. Naturforscherversammlung zu Lubeck. Verhandlungen ii. Ueber die menschliche Eikammer u. Decidua reflexa. Verhandlungen d. anat. Gesellsch. , Versammlung zu Kiel, 1898. Beobachtungen an einer menschlichen Keimscheibe mit offener Medullarrinne u. Canalis neurentericus, Arch. f. Anat. u. Physiolog., Anat. Abth., 1889.

Strahl: Untersuchungen über den Bau der Placenta. Die Anlagerung des Eis an die Uteruswand. Arch. f. Anat. u. Physiolog. Anatomische Abth. 1889, i. Fortsetzung ii. Archiv f. Anat. und Physiolog. Anat. Abth. Supplement, 1889. Der Bau der Hundeplacenta. Arch. f. Anat. und Physiolog. Anat., Abth., 1890. Die histologischen Veränderungen d. Uterusepithel. in der Raubthierplacenta. Arch. f. Anat. und Physiolog., Supplement., 1890. Ergebnisse der Anat. und Entwickelungsgeschichte. Thierplacenta. Merkel u. Bonnet, 1892, Bd. i. Menschliche Placenta, 1892, Bd. ii. Naturforscherversammlung zu Braunschweig.

Verhand. ii. Ueber d. Placenta der Raubthiere. Ueber d. Bau d. Placenta von Talpa europea und über Placentardrüsen. Anatom. Anzeiger, 1890, Nr. 13 u. 14.

Stratz: Ueber Placenta prævia. Zeitschr. f. Geburtsh. u. Gyn., Bd. xxvi.

Tafani: Sulle condizioni uteroplacentari della vita fetale. Mem. della R. Instituto di studii superiori pratici e di perfezionamente in Firenze, 1886.

Thomson, Allen: Contributions to the history of the structure of the human ovum and embryo before the third week after conception, with a description of some early ova. The Edinburgh Medical and Surgical Journal, 1839.

Turner: On the placentation of the apes with a comparison of the structure of their placenta with that of the human female. London Philosoph. Transact., 1878. Some general observations on the placenta with especial reference to the theory of evolution. Journal Anat. and Physiol., 1877. Lectures on the Comparative Anatomy of the Placenta, Edinburgh, 1876.

V. Tussenbroek, Catherine: Observations on Human Placentation in its second stage. Brit Med. Journ., Sept. 15, 1900.

Ulesco Stroganova: Beiträge zur Lehre vom mikroskop. Bau der Placenta. Monatsschr. f. Geburtsh. u. Gyn., iii, 3.

Vernhout: Ueber die Placenta des Maulwurfes. Anat., Hft. von Merkel u. Bonnet, I. Abth., Hft. 14.

Virchow: Ueber die Bildung der Placenta. Gesammelte Abhandlungen, ii.

Waldeyer: Die Placenta von Inuus nemestrinus. Sitzungsber. d. Konigl. Pr. Akad. d. Wissensch., Berlin, 1889. Eierstock und Ei, Leipzig, 1870. Bemerkungen über d. Bau d. Menschen u. Affenplacenta. Arch. f. Mikros. Anat., Bd. xxxv.

Waldeyer: Ueber Bindegewebszellen. Arch. f. mikros. Anat., 1875, Bd. xi. Ueber d. Placentarkreislauf d. Menschen Sitzungsber d. königl. Akad. d. Wissensch. 3. Febr., 1887.

Webster, Clarence: Ectopic Pregnancy, Edinburgh, 1895. Researches in Female Pelvic Anatomy, Edinburgh, 1892.

Williams, Whitridge: Contributions to the Science of Medicine, 1900.

Winkler: Textur, Structur und Zelleben in den Adnexen des menschlichen Eies, Jena, 1870. Zur Kenntniss der menschlichen Placenta, Arch. f. Gyn., Bd. iv, Heft. 2, 1872.

Young: Development and structure of the placenta. Med. Chron., Nov., 1896. On some recent observations on the development and structure of the Placenta. Med. Chronicle, Manchester, 1891, Vol. xiv.

PLATE II.

FIG. 1.—NORMAL UTERINE MUCOSA OF ADULT NULLIPARA.

a, mucosa; *b*, muscular wall of uterus; *c*, glands; *d*, surface of mucosa.

Note the irregular line of junction of mucosa and muscle and the extension downward into the taller of several glands. No longitudinal sections of glands are seen in this section. X. 40.

FIG. 2.—ANOTHER SECTION OF THE SAME.

a, surface of mucosa; *b*, muscular part of wall; *c*, lower ends of glands.

Note that the mucosa is thicker than in Fig. 1, and that the glands are more numerous. X. 40

FIG. 3.—ANOTHER SECTION OF THE SAME.

a, surface of mucosa; *b*, muscular part of wall; *c*, lower ends of glands; *d*, wavy course of gland.

Fewer glands are seen than in Fig. 2.

The wavy or tortuous course of several glands is seen. X. 40.

FIG. 4.—OUTER PART OF MUCOSA.

a, surface columnar epithelium under which a fine dark line, the basement membrane, may be seen; *b*, basement membrane; *c*, glandular epithelium. X. 80.

FIG. 5.—INTERGLANDULAR TISSUE.

a, cells of various sizes; *b*, capillary vessel. X. 300.

FIG. 6.—PART OF A GLAND AND INTERGLANDULAR TISSUE.

a, cells of interglandular tissue; *b*, columnar epithelium of gland; *c*, basement membrane of glandular epithelium. It is of connective tissue origin. X. 300.

FIG. 7.—ANOTHER SECTION OF THE SAME.

a, cells of interglandular tissue; *b*, basement membrane of gland; *c*, glandular epithelium which is separated from its basement membrane. X. 300.

FIG. 8.—INTERGLANDULAR TISSUE OF COMPACT LAYER OF DECIDUA VERA AT FOURTH WEEK.

Connective tissue cells of various sizes are seen—different stages in the formation of decidual cells.

a, decidual cells; *b*, connective tissue cell slightly enlarged; *c*, leucocyte. X. 290.

PLATE II.

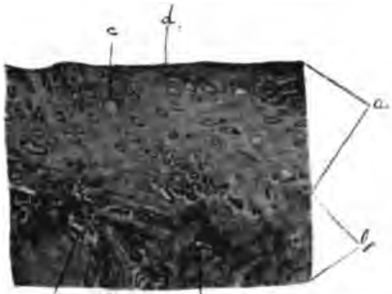

Fig. 1

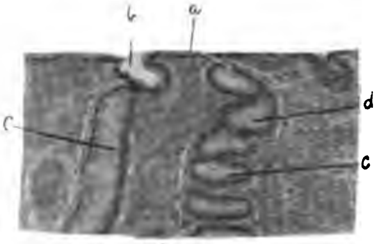

Fig. 4

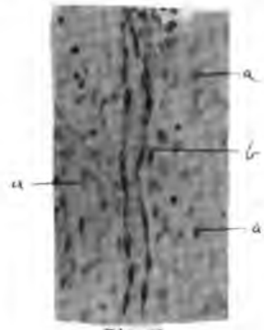

Fig. 5

Fig 2

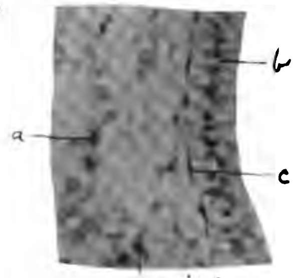

Fig 6

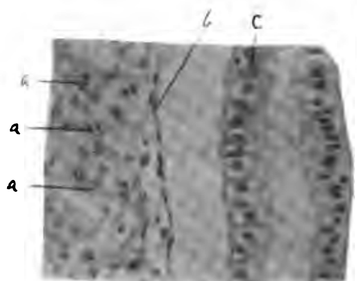

Fig. 7

Fig 3

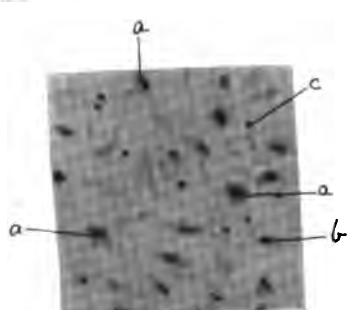

Fig. 8

PLATE III.

FIG. 9.—INTERGLANDULAR TISSUE OF COMPACT LAYER OF DECIDUA VERA AT FOURTH WEEK.

a, decidual cells, many are spindle-shaped; *b*, capillary enlarging to form a sinus; *c*, flattened cell on wall of sinus. X. 290.

FIG. 10.—ANOTHER OF THE SAME, NEAR SPONGY LAYER.

Here there are fewer decidual cells. X. 290.

FIG. 11.—DECIDUA VERA. UPPER PART OF COMPACT LAYER. SIX-WEEK PREGNANT UTERUS.

a, surface covered with epithelium, somewhat flattened from original columnar condition and broken off in parts; *b*, gland-space, epithelium largely cast off and degenerating; *c*, dilated capillary. X. 40.

FIG. 12.—ANOTHER OF THE SAME.

a, surface with covering epithelium which has become somewhat flattened; *b*, glands, some are much compressed; *c*, solid decidual tissue. X. 25.

FIG. 13.—ANOTHER OF THE SAME.

a, surface of vera; *b*, interglandular decidual tissue; *c*, dilated capillary; *d*, gland-space of spongy layer; *e*, partly obliterated gland in compact layer. X. 25.

FIG. 14.—ANOTHER OF THE SAME.

a, surface; *b*, gland being obliterated; *c*, decidual cells; *d*, dilated capillaries; *e*, blood effused among decidual cells. X. 40.

PLATE III.

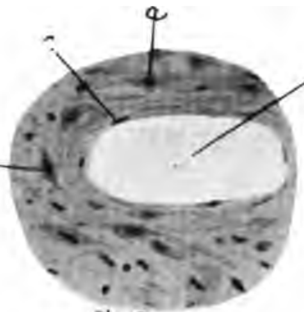

Fig. 9

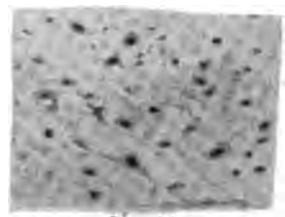
Fig. 10

Fig. 11

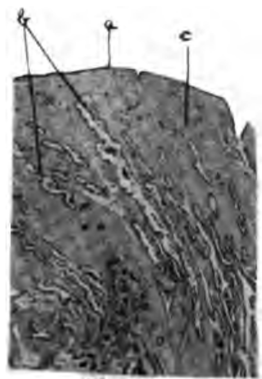

Fig. 12

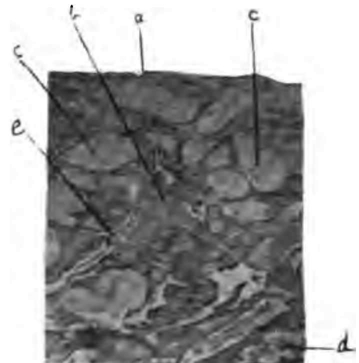

Fig. 13

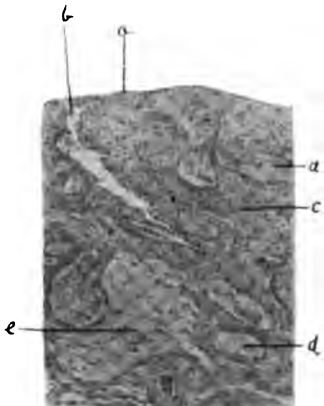

Fig. 14

PLATE IV.

FIG. 15.—DECIDUA VERA. COMPACT LAYER. SIX-WEEK PREGNANCY.

a, surface; *b*, decidual cells; *c*, glands not yet obliterated, their epithelium has disappeared. X. 40.

FIG. 16.—JUNCTION OF COMPACT AND SPONGY LAYERS OF VERA IN SIX-WEEK SPECIMEN.

a, compact layer; *b*, capillary somewhat dilated; *c*, trabecula between two gland-spaces; *d*, gland-space with lining epithelium largely cast off. X. 40.

FIG. 17.—UPPER PART OF SPONGY LAYER FROM A SIX-WEEK SPECIMEN.

a, trabecula between gland spaces; *b*, débris in gland-spaces. X. 40.

FIG. 18.—ANOTHER FROM SAME.

a, trabecula; *b*, degenerating epithelium in gland-spaces; *c*, blood-sinus.
Note that gland-spaces are mostly parallel to surface of mucosa. Decidual cells in the upper part are larger than those in the lower. X. 40.

FIG. 19.—ANOTHER FROM SAME.

a, trabecula; *b*, gland-space containing degenerating cells. The gland is tortuous and wide. X. 40.

FIG. 20.—LOWER PART OF SPONGY LAYER FROM SAME SPECIMEN.

a, trabecula of spongy layer; *b*, decidual island; *c*, junction of spongy layer and muscle; *d*, muscular part of wall. X. 25.

PLATE IV.

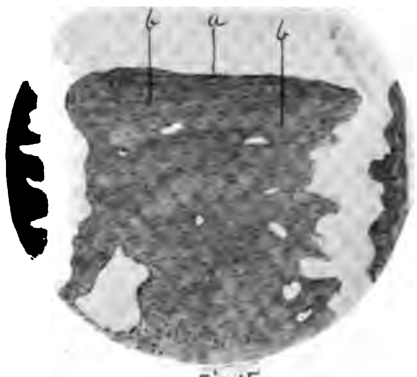

Fig. 15

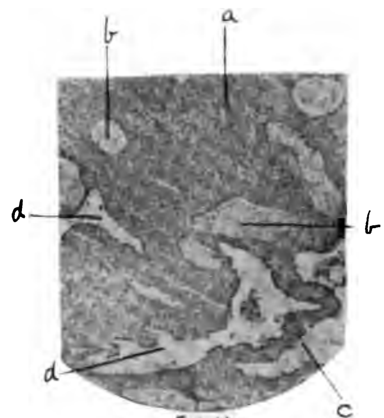

Fig. 16

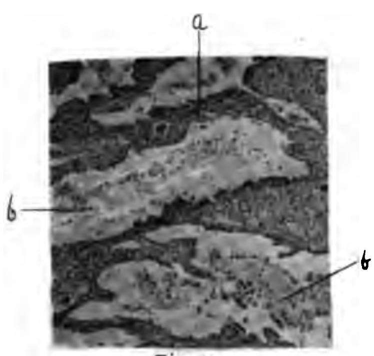

Fig. 17

Fig. 18

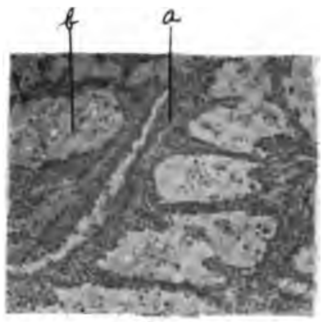

Fig. 19

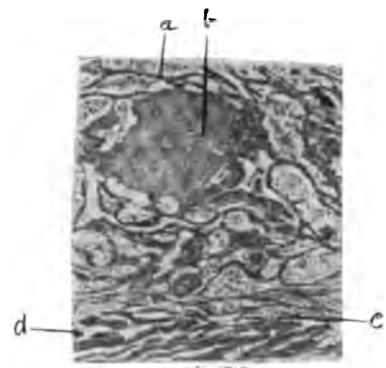

Fig. 20

PLATE V.

FIG. 21.—LOWER PART OF SPONGY LAYER. SIX-WEEK PREGNANCY.

a, trabecula of spongy layer: *b*, decidual island: *c*, degenerating epithelium in gland-space. X. 40.

FIG. 22.—ANOTHER FROM SAME.

a, trabecula of spongy layer: *b*, gland with epithelium still on wall: *c*, gland-space with degenerating epithelium.

In some glands the epithelium is still attached to the walls.

The glands are mostly parallel to muscle of uterine wall. X 40

FIG 23.—ANOTHER FROM SAME.

a, decidual tissue between glands: *b*, gland-spaces: *c*, glands which extend into muscular layer of wall: *d*, muscular layer.

The gland epithelium is still attached to most of the gland-walls. X. 25.

FIG. 24.—ANOTHER FROM SAME..

a, gland-space: *b*, junction of spongy layer and muscle: *c*, muscle.

Most of these gland-spaces contain cast-off degenerating epithelium. X. 25.

FIG. 25.—ANOTHER FROM SAME.

a, gland-spaces; b, muscle of wall: *c*, vessels in muscular layer. X. 40.

FIG. 26.—ANOTHER SECTION FROM SIX-WEEK SPECIMEN.

a, gland with epithelium preserved on wall: *b*, decidual cells. X. 40.

FIG. 27.—SECTION OF COMPACT LAYER OF THE VERA FROM SAME SPECIMEN.

a, surface epithelium, somewhat flattened and broken up: *b*, large branching decidual cell in the midst of a blood-extravasation: *c*, blood: *d*, closely packed decidual tissue; cells are mainly parallel to surface. X. 300.

PLATE V.

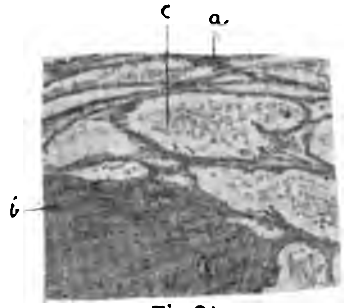

Fig. 21

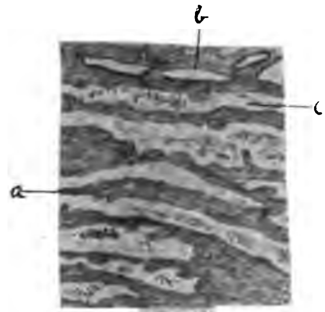

Fig. 22

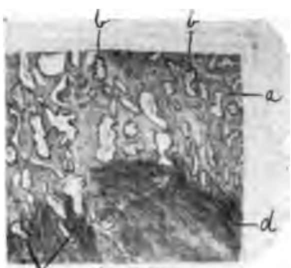

Fig. 23

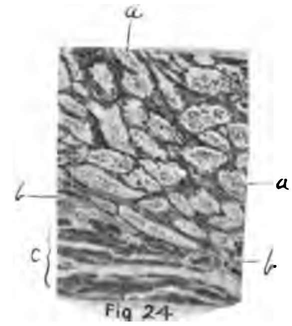

Fig. 24

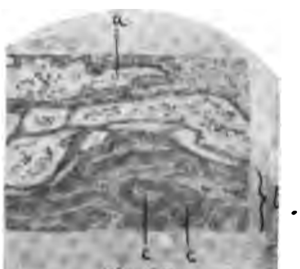

Fig. 25

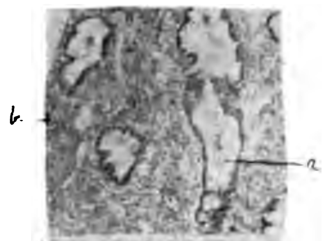

Fig. 26

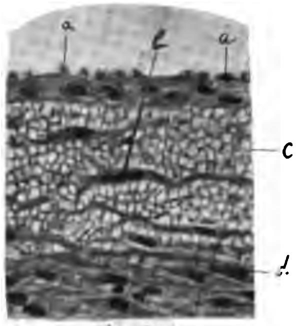

Fig. 27

PLATE VI.

FIG. 28.—COMPACT LAYER OF VERA. SIX-WEEK PREGNANCY.

a, surface-epithelium, somewhat degenerated; *b*, large decidual cells; *c*, large multi-nucleated decidual cell; *d*, leucocyte; *e*, capillary. X. 340.

FIG. 29.—ANOTHER FROM SAME.

a, surface-epithelium, degenerating; *b*, decidual tissue, with largely obliterated cell outline; *c*, blood-sinus. X. 300.

FIG. 30.—ANOTHER FROM THE SAME.

a, surface-epithelium, cubical in shape; *b*, blood-sinus; *c*, endothelial cell on sinus-wall; *d*, decidual cell. X. 300.

FIG. 31.—ANOTHER FROM THE SAME.

a, remains of surface epithelium; *b*, decidual cell; *c*, blood tearing up decidual tissue. X. 300.

FIG. 32.—ANOTHER FROM THE SAME.

a, decidual cells; *b*, blood. X. 300.

FIG. 33.—ANOTHER FROM THE SAME.

a, blood-sinus; *b*, decidual cells and leucocytes; *c*, endothelial cell. X. 300.

FIG. 34.—ANOTHER FROM THE SAME

a, densely packed decidual tissue; *b*, blood. X. 300.

PLATE VI.

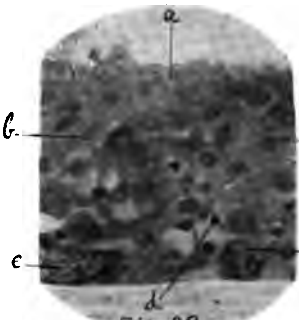

Fig. 28

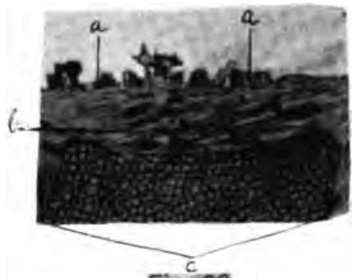

Fig. 29

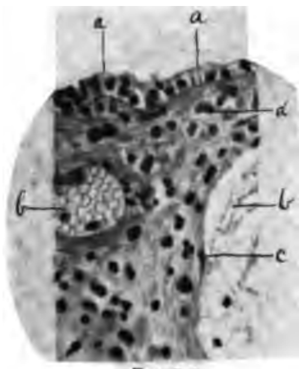

Fig 30

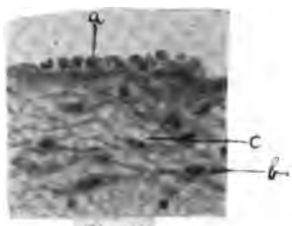

Fig. 31

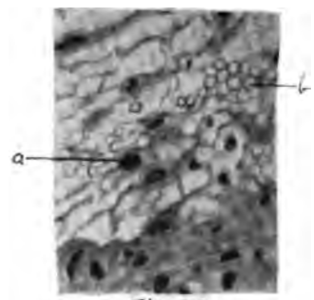

Fig. 32

Fig. 33

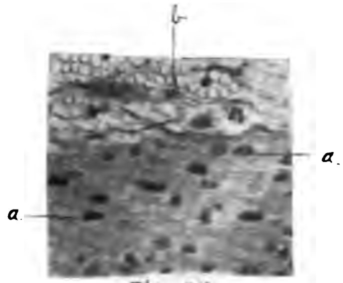

Fig. 34

PLATE VII.

FIG. 35.—COMPACT LAYER OF VERA. SIX-WEEK PREGNANCY.

a, decidual tissue; *b*, gland with degenerating epithelium in its lumen; *c*, blood-sinus. X. 300.

FIG. 36.—ANOTHER FROM THE SAME.

a, very large decidual cell; *b*, smaller decidual cell; *c*, blood-sinus. X. 300.

FIG. 37.—SECTION OF SPONGY LAYER FROM SIX-WEEK SPECIMEN.

a, decidual cells of trabecula; *b*, wall of gland denuded of epithelium; *c*, cast-off epithelium of gland in various stages of degeneration. X. 300.

FIG. 38.—ANOTHER FROM THE SAME.

a, wall of gland, considerable amount of epithelium attached; *b*, inter-glandular trabecula; *c*, cast-off cells of another gland-space. X. 300.

FIG 39.—COMPACT LAYER OF DECIDUA VERA. SIX-WEEK SPECIMEN.

a, large decidual cell; *b*, leucocyte.
Note the different shapes of decidual cells. X. 300.

FIG. 40.—ANOTHER OF THE SAME.

a, blood-sinus; *b*, endothelial cells; *c*, decidual cell. X. 300.

FIG. 41.—ANOTHER OF THE SAME.

a, large decidual cells; *b*, capillary vessel, enlarged. X. 300.

FIG. 42.—ANOTHER FROM THE SAME.

a, decidual cells; *b*, blood from decidual vessels extravasated into decidual tissue. X. 300.

PLATE II.

Fig. 1

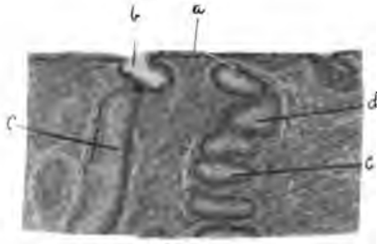

Fig. 4

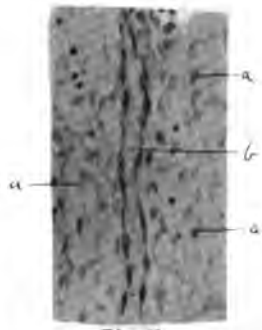

Fig. 5

Fig 2

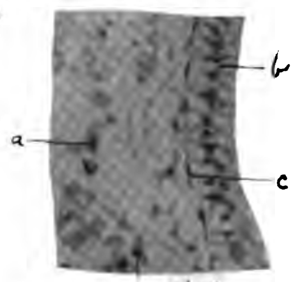

Fig 6

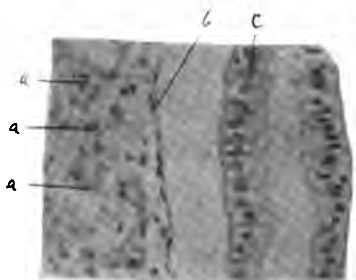

Fig. 7

Fig 3

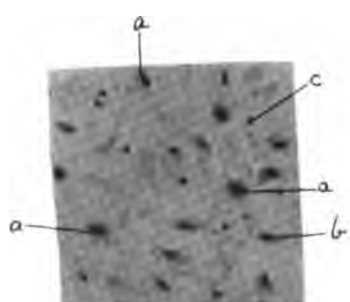

Fig. 8

PLATE VIII.

Fig. 43.—Compact Layer of Decidua Vera. Six-Week Pregnancy.

a, decidual cells with very large nuclei. One cell has two nuclei; *b*, small decidual cells and leucocytes. X. 300.

Fig. 44.—Another from the Same.

a, large decidual cell; *b*, leucocyte. X. 300.

Fig. 45.—Another from the Same.

a, elongated spindle-shaped decidual cells, arranged parallel to surface. X. 300.

Fig. 46.—Section Through Inner Part of Uterine Wall, Non-Placental Area, in Fourth Month of Pregnancy.

a, interglandular tissue; b, gland-spaces; *c*, muscular part of wall; *d*, amnion; *e*, chorion.

In this section there is no well-marked distinction between compact and spongy layers. X. 25.

Fig. 47.—Another Section from Same.

a, flattened cells of wall of gland; *b*, large decidual cells parallel with surface; *c*, leucocytes. X. 300.

Fig. 48.—Another from the Same.

a, thin trabecula of spongy layer; *b*, débris of cast-off epithelium of gland; *c*, lumen of a gland from which all the epithelium has disappeared; *d*, muscular part of uterine wall. X. 80.

Fig. 49.—Another from the Same.

a, thin trabecula of spongy layer; *b*, cast-off epithelial cells in gland lumen. X. 300

PLATE III.

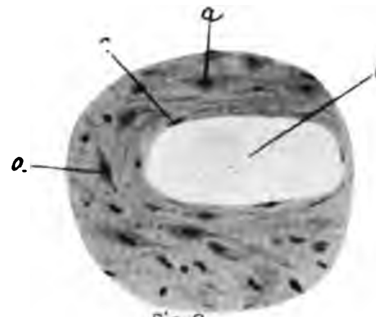

Fig. 9

Fig. 10

Fig. 11

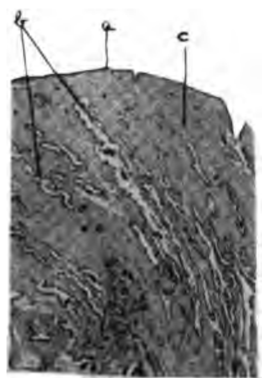

Fig. 12

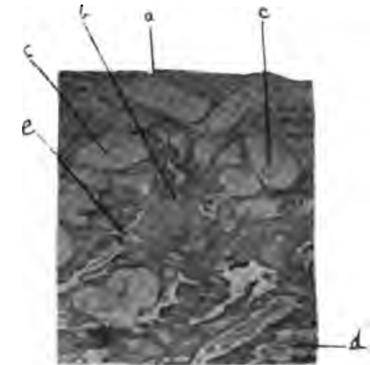

Fig. 13

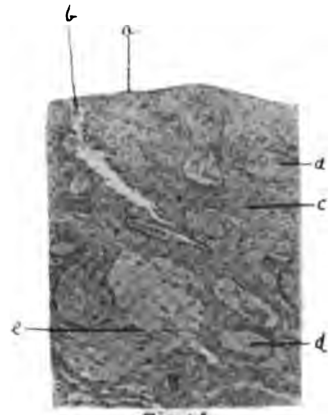

Fig. 14

PLATE IV.

FIG. 15.—DECIDUA VERA. COMPACT LAYER. SIX-WEEK PREGNANCY.

a, surface; *b*, decidual cells; *c*, glands not yet obliterated, their epithelium has disappeared. X. 40.

FIG. 16.—JUNCTION OF COMPACT AND SPONGY LAYERS OF VERA IN SIX-WEEK SPECIMEN.

a, compact layer; *b*, capillary somewhat dilated; *c*, trabecula between two gland-spaces; *d*, gland-space with lining epithelium largely cast off. X. 40.

FIG. 17.—UPPER PART OF SPONGY LAYER FROM A SIX-WEEK SPECIMEN.

a, trabecula between gland spaces; *b*, débris in gland-spaces. X. 40.

FIG. 18.—ANOTHER FROM SAME.

a, trabecula; *b*, degenerating epithelium in gland-spaces; *c*, blood-sinus.
Note that gland-spaces are mostly parallel to surface of mucosa. Decidual cells in the upper part are larger than those in the lower. X. 40.

FIG. 19.—ANOTHER FROM SAME.

a, trabecula; *b*, gland-space containing degenerating cells. The gland is tortuous and wide. X. 40.

FIG. 20.—LOWER PART OF SPONGY LAYER FROM SAME SPECIMEN.

a, trabecula of spongy layer; *b*, decidual island; *c*, junction of spongy layer and muscle; *d*, muscular part of wall. X. 25.

PLATE IV.

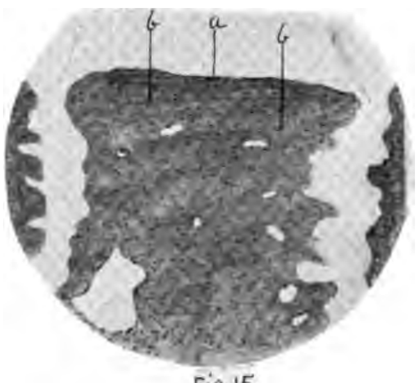

Fig. 15

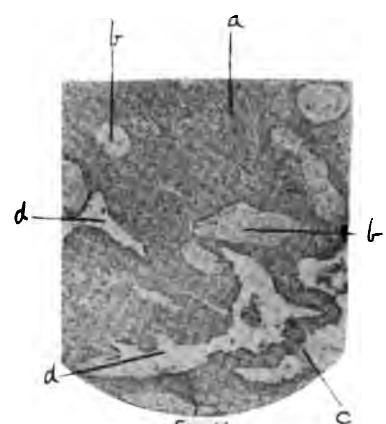

Fig. 16

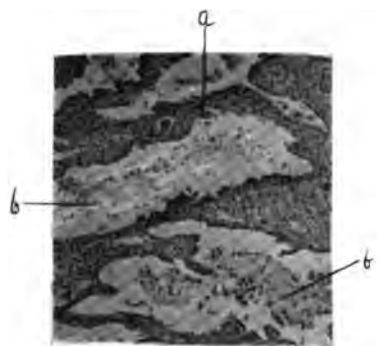

Fig. 17

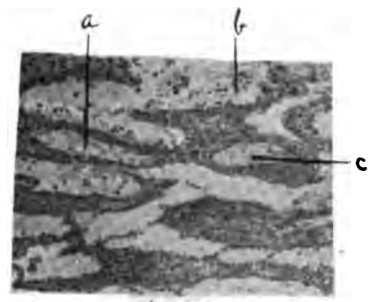

Fig. 18

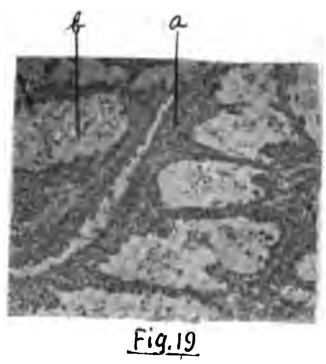

Fig. 19

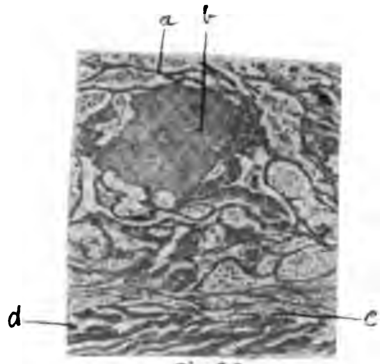

Fig. 20

PLATE X.

FIG. 57.—SECTION OF VERA. SIX-WEEK PREGNANCY.

a, decidual cells; *b*, inter-cellular homogeneous matrix.
Note how indistinct are the cell outlines. X. 290.

FIG. 58.—SECTION OF VERA AND CHORION FROM SAME.

a, decidua; *b*, chorionic epithelium; *c*, chorionic connective tissue; *d*, fibrinous degenerated layer on surface of vera; rarely found in the non-placental area. X. 300.

FIG. 59.—ANOTHER FROM THE SAME.

a, lower portions of decidua; *b*, muscular part of wall; *c*, gland-space with cast-off degenerated epithelium. X. 290.

FIG. 60.—ANOTHER FROM THE SAME.

a, decidua; *b*, muscle; *c*, a single layer of glandular epithelium somewhat flattened and compressed between decidua and muscle. X. 300.

FIG. 61.—ANOTHER FROM THE SAME.

a, decidua; *b*, muscle; *c*, gland-space at junction of decidua and muscle with epithelium somewhat lower than normal, attached to wall. X. 300.

FIG. 62.—SECTION THROUGH UPPER PART OF VERA, CHORION AND AMNION, FROM A SPECIMEN OF FULL TIME PREGNANCY.

a, thickened chorionic epithelium; *b*, loose decidual tissue; *c*, gland-space; *d*, old degenerated villi embedded between chorionic tissue and decidua; *e*, junction of chorionic epithelium and connective tissue; *f*, epithelium of amnion; *g*, connective tissue of chorion and amnion.

FIG. 63.—SECTION THROUGH VERA AND MEMBRANES, CLOSE TO PLACENTA, FROM A FULL-TIME SPECIMEN.

a, compact layer of vera; *b*, hemorrhage in decidua; *c*, gland-spaces of decidua; *d*, amnion; *c*, line of junction of decidua and muscle; *f*, chorionic epithelium. X. 25.

FIG. 64.—ANOTHER FROM THE SAME.

a, compact decidual tissue; *b*, thin trabecula of spongy layer; *c*, large gland-space; *d*, muscular wall of uterus; *e*, blood-vessel; *f*, amnion; *g*, chorion; *h*, remains of villi of the chorion læve compressed against the decidua. X. 25.

FIG. 65.—ANOTHER SECTION FROM THE SAME.

a, amnion, chorion and decidua blended; note the small amount of decidual tissue; *b*, muscular wall of uterus; *c*, delicate trabecula of decidual tissue. X. 25.

PLATE V.

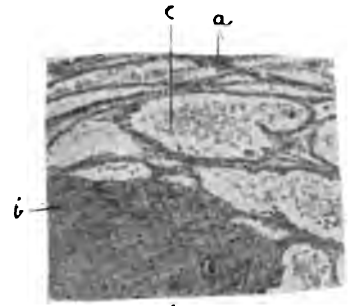

Fig.21

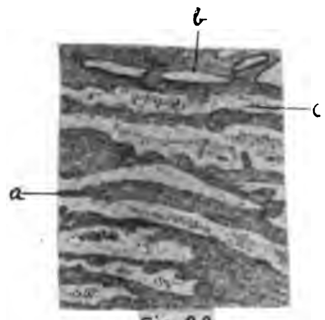

Fig.22

Fig 23

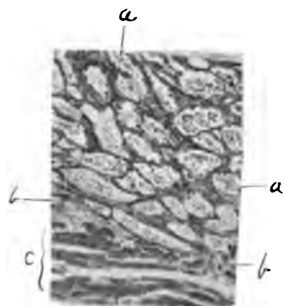

Fig 24

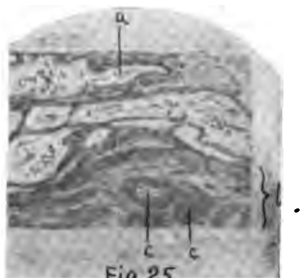

Fig.25

Fig 26

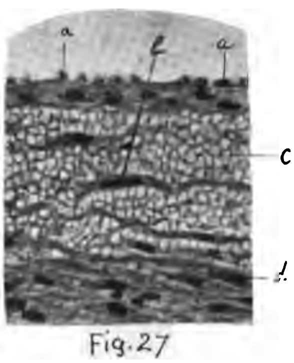

Fig.27

PLATE XI.

FIG. 66.—SECTION THROUGH VERA AND MEMBRANES, CLOSE TO PLACENTA. FULL-TIME PREGNANCY.

a, decidua, close to serotina; *b*, blood-vessel; *c*, mass of plasmodium; note the contrast between it and the decidua; *d*, chorionic epithelium; *e*, amnion. X. 80.

FIG. 67.—ANOTHER FROM THE SAME.

a, muscular wall of uterus; *b*, compact layer of uterus; *c*, gland-spaces at junction of decidua and muscle; *d*, chorion; *e*, amnion; *f*, remains of a villus. X. 25

FIG. 68.—ANOTHER FROM THE SAME.

a, decidua vera, compact layer, close to serotina; *b*, marked fibrinous or hyaline degeneration in the decidua; *c*, plasmodial mass. X. 80.

FIG. 69.—ANOTHER FROM THE SAME.

a, trabecula of spongy layer; *b*, gland-space; *c*, muscular part of wall; *d*, artery with thickened intima. X. 80

FIG. 70.—ANOTHER SECTION FROM FULL-TIME SPECIMEN.

Various sizes of decidual cells of compact layer of vera. A few leucocytes are seen. X. 300.

FIG. 71.—ANOTHER FROM THE SAME.

Various sizes of decidual cells. A few leucocytes are seen. X. 300.

FIG. 72.—SECTION OF PART OF UTERINE WALL WITH MEMBRANES FROM A FULL-TIME UTERUS REMOVED BY PORRO'S OPERATION.

a, vera arranged in a crumpled condition; *b*, muscular part of uterine wall; *c*, amnion; *d*, chorion. X. 25.

FIG. 73.—SECTION FROM A FOUR-WEEKS PREGNANCY.

a, vera; *b*, space between vera and reflexa; *c*, reflexa; *d*, inner part of reflexa, in a state of fibrinous or hyaline degeneration; *e*, villi of chorion læve. X. 25.

PLATE VI.

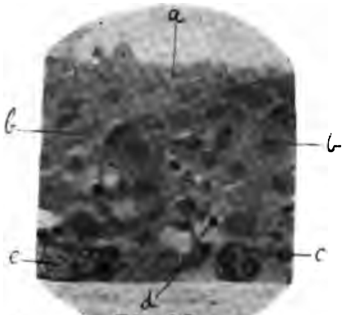

Fig. 28

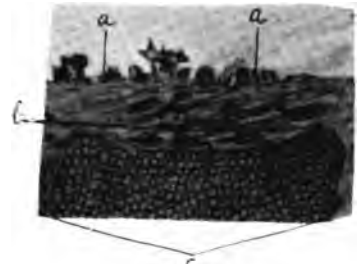

Fig. 29

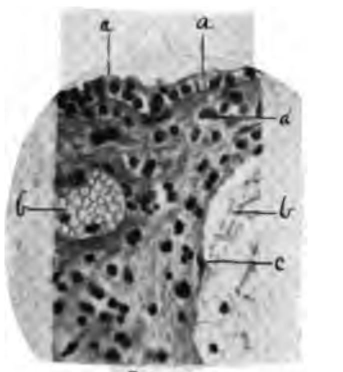

Fig 30

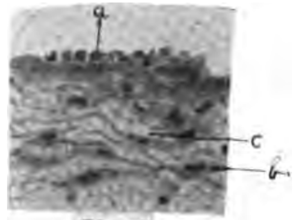

Fig. 31

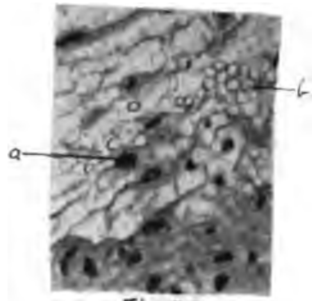

Fig 32

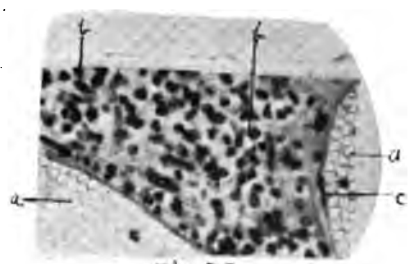

Fig. 33

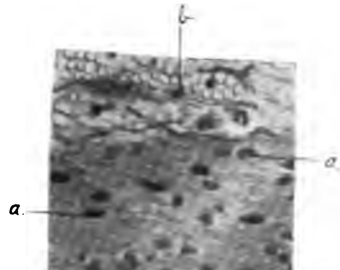

Fig. 34

PLATE XII.

FIG. 74.—SECTION OF REFLEXA NEAR SEROTINA, FROM FOUR-WEEK PREGNANCY.

a, decidual tissue; *b*. gland-space; c. blood sinus X. 290.

FIG. 75.—SECTION FROM FOUR-MONTH PREGNANT UTERUS.

a, compact layer of vera or of blended vera and reflexa; *b*. spongy layer; *c*, remains of villi of chorion læve; *d*. muscle; *e*, delicate tissue joining chorion and amnion; *f*, chorionic epithelium; *g*, amnion. X. 25.

FIG. 76.—ANOTHER FROM THE SAME.

a. reflexa with blood-sinuses and gland-spaces; *b*, outer part of reflexa greatly torn by extravasated blood; *c*. villi of chorion læve; *d*, chorion; *e*, amnion. X. 25.

FIG. 77.—ANOTHER FROM THE SAME.

Junction of reflexa, vera and serotina.

a, vera; *b*, edge of serotina; *c*. reflexa; *d*, blood extravasation into outer part of reflexa; *e*. amnion; *f*, villi; *g*, chorion. X. 25.

FIG. 78.—SECTION FROM SIX-WEEK COMPLETE ABORTION.

a, inner part of reflexa; *b*. outer part of reflexa; *c*. space between vera and reflexa; *d*, vera; *e*, villi. X. 25.

FIG 79.—SECTION FROM SIX-WEEK PREGNANT UTERUS.

a, reflexa close to serotina; *b*, extensive blood extravasation at junction of serotina and reflexa; *c*, vera; *d*, space between vera and reflexa; *e*, reflexa, a short distance from its base; *f*, villi of chorion læve. X. 25.

FIG. 80.—SECTION FROM FOUR-MONTH PREGNANT UTERUS.

It shows reflexa and villi of so-called "reflexa placenta."

a, vera; *b*, reflexa; *c*, fibrinous degeneration in reflexa; *d*, villus attached to reflexa; *e*, free villus; *f*, amnion; *g*, chorion. X. 25.

PLATE VII.

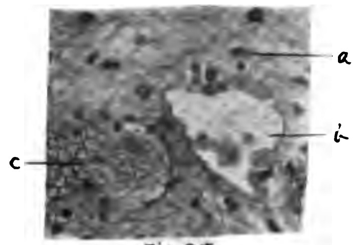

Fig. 35

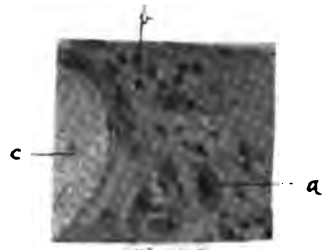

Fig. 36

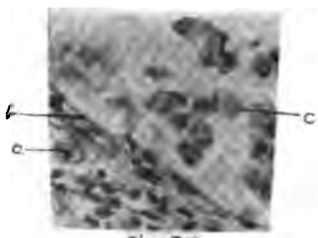

Fig. 37

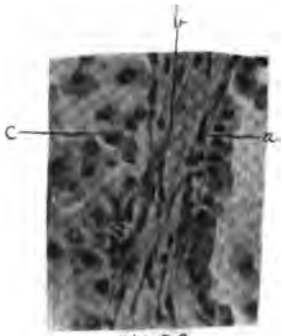

Fig. 38

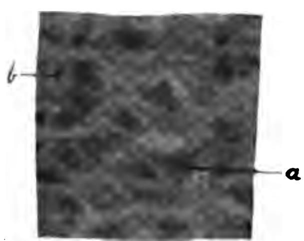

Fig. 39

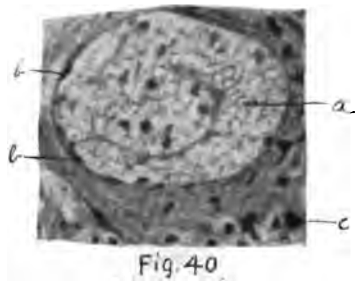

Fig. 40

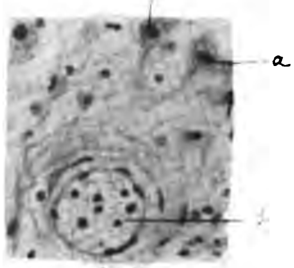

Fig. 41

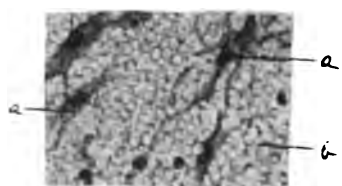

Fig. 42

PLATE VIII.

FIG. 43.—COMPACT LAYER OF DECIDUA VERA. SIX-WEEK PREGNANCY.

a, decidual cells with very large nuclei. One cell has two nuclei; *b*, small decidual cells and leucocytes. X. 300.

FIG. 44.—ANOTHER FROM THE SAME.

a, large decidual cell; *b*, leucocyte. X. 300.

FIG. 45.—ANOTHER FROM THE SAME.

a, elongated spindle-shaped decidual cells, arranged parallel to surface. X. 300.

FIG. 46.—SECTION THROUGH INNER PART OF UTERINE WALL. NON-PLACENTAL AREA, IN FOURTH MONTH OF PREGNANCY.

a, interglandular tissue; b, gland-spaces; *c*, muscular part of wall; *d*, amnion; *e*, chorion.

In this section there is no well-marked distinction between compact and spongy layers. X. 25.

FIG. 47.—ANOTHER SECTION FROM SAME.

a, flattened cells of wall of gland; *b*, large decidual cells parallel with surface; *c*, leucocytes. X. 300.

FIG. 48.—ANOTHER FROM THE SAME.

a, thin trabecula of spongy layer; *b*, débris of cast-off epithelium of gland; *c*, lumen of a gland from which all the epithelium has disappeared; *d*, muscular part of uterine wall. X. 80.

FIG. 49.—ANOTHER FROM THE SAME.

a, thin trabecula of spongy layer; *b*, cast-off epithelial cells in gland lumen. X. 300

PLATE VIII.

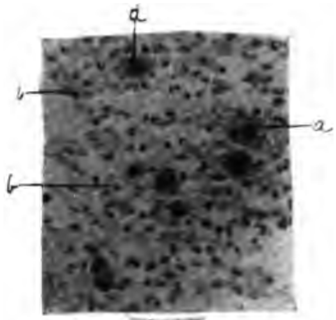

Fig.43

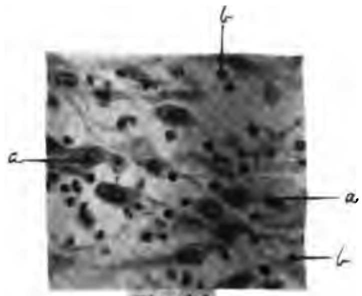

Fig. 44

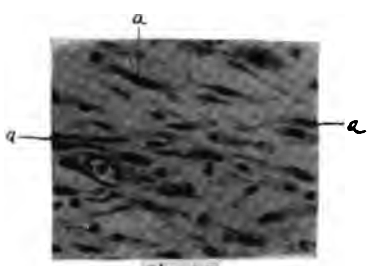

Fig.45

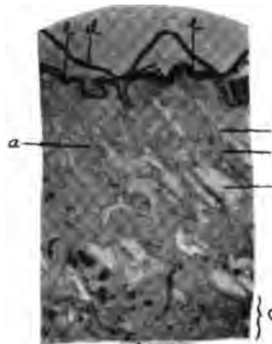

Fig.46

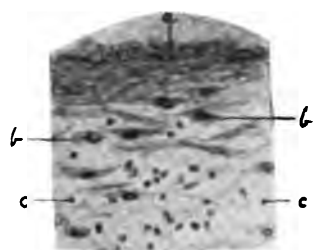

Fig.47

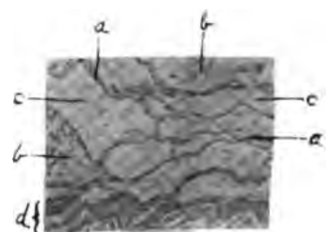

Fig.48

Fig.49

PLATE IX.

FIG. 50.—SECTION THROUGH INNER PART OF UTERINE WALL. NON-PLACENTAL AREA IN SIXTH MONTH OF PREGNANCY.

a, decidual tissue: *b*, muscular part of wall; *c*, remains of gland-spaces; *d*, amnion; *e*, chorion; *f*, fibrin layer between chorion and vera.

Note how few glands are in this section. The vera is mainly compact. X. 80.

FIG. 51.—ANOTHER FROM THE SAME.

a, muscle: *b*, vera, more spongy and thinner than in last section; *c*, gland-spaces at junction of decidua and muscle: *d*, chorion: *e*, amnion. X. 25.

FIG. 52.—ANOTHER FROM THE SAME.

a, trabecula between gland-spaces: *b*, gland-space; *c*, muscle: *d*, amnion.

The decidua is spongy throughout in this section. X. 25.

FIG. 53.—ANOTHER FROM THE SAME.

a, decidua; *b*, gland-spaces parallel with the surface: *c*, muscle; *d*, amnion. X. 25.

FIG. 54.—ANOTHER SECTION FROM SIX-MONTH SPECIMEN.

a, decidua; no distinction can be made between compact and spongy layer; *b*, remains of gland-spaces next muscle; *c*, muscular part of wall; *d*, chorion; *e*, amnion. X. 80.

FIG. 55.—ANOTHER FROM THE SAME.

a, compact and spongy decidua; *b*, gland-space; *c*, muscle of uterine wall; *d*, amnion; *e*, chorionic epithelium; *f*, villi imbedded between chorion and decidua. X. 80.

FIG. 56.—ANOTHER FROM THE SAME.

a, decidua; *b*, muscular part of wall: *c*, amnion; *d*, chorion: *e*, gland-space X. 25.

PLATE IX.

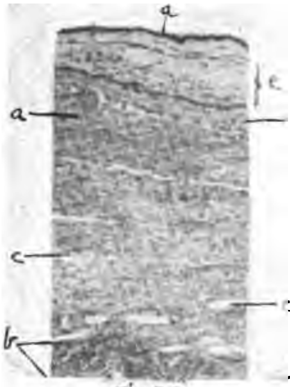

Fig:50

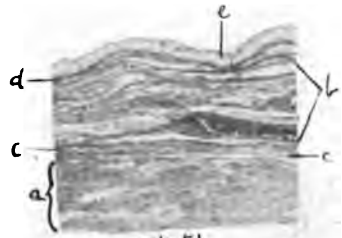

Fig.51

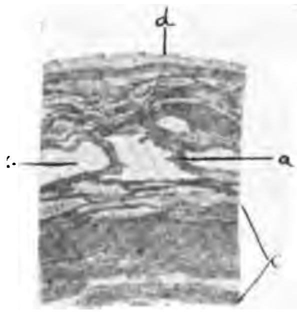

Fig.52

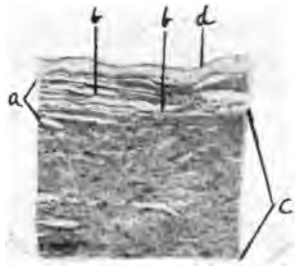

Fig.53

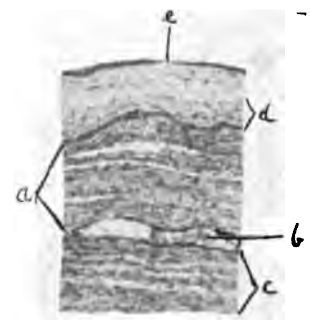

Fig54

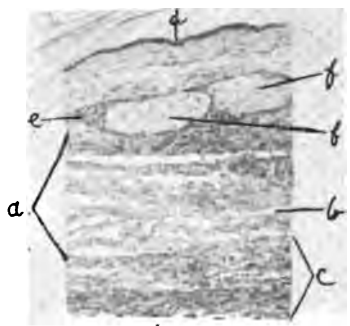

Fig 55

Fig.56

PLATE X.

FIG. 57.—SECTION OF VERA. SIX-WEEK PREGNANCY.

a, decidual cells; *b*, inter-cellular homogeneous matrix.
Note how indistinct are the cell outlines. X. 290.

FIG. 58.—SECTION OF VERA AND CHORION FROM SAME.

a, decidua; *b*, chorionic epithelium; *c*, chorionic connective tissue; *d*, fibrinous degenerated layer on surface of vera; rarely found in the non-placental area. X. 300.

FIG. 59.—ANOTHER FROM THE SAME.

a, lower portions of decidua; *b*, muscular part of wall; *c*, gland-space with cast-off degenerated epithelium. X. 290.

FIG. 60.—ANOTHER FROM THE SAME.

a, decidua; *b*, muscle; *c*, a single layer of glandular epithelium somewhat flattened and compressed between decidua and muscle. X. 300.

FIG. 61.—ANOTHER FROM THE SAME.

a, decidua; *b*, muscle; *c*, gland-space at junction of decidua and muscle with epithelium somewhat lower than normal, attached to wall. X. 300.

FIG. 62.—SECTION THROUGH UPPER PART OF VERA, CHORION AND AMNION, FROM A SPECIMEN OF FULL TIME PREGNANCY.

a, thickened chorionic epithelium; *b*, loose decidual tissue; *c*, gland-space; *d*, old degenerated villi embedded between chorionic tissue and decidua; *e*, junction of chorionic epithelium and connective tissue; *f*, epithelium of amnion; *g*, connective tissue of chorion and amnion.

FIG. 63.—SECTION THROUGH VERA AND MEMBRANES, CLOSE TO PLACENTA, FROM A FULL-TIME SPECIMEN.

a, compact layer of vera; *b*, hemorrhage in decidua; *c*. gland-spaces of decidua; *d*, amnion; *e*, line of junction of decidua and muscle; *f*, chorionic epithelium. X. 25.

FIG. 64.—ANOTHER FROM THE SAME.

a, compact decidual tissue; *b*, thin trabecula of spongy layer; *c*, large gland-space; *d*, muscular wall of uterus; *e*, blood-vessel; *f*, amnion; *g*, chorion; *h*, remains of villi of the chorion læve compressed against the decidua. X. 25.

FIG. 65.—ANOTHER SECTION FROM THE SAME.

a, amnion, chorion and decidua blended; note the small amount of decidual tissue; *b*, muscular wall of uterus; *c*, delicate trabecula of decidual tissue. X. 25.

PLATE XV.

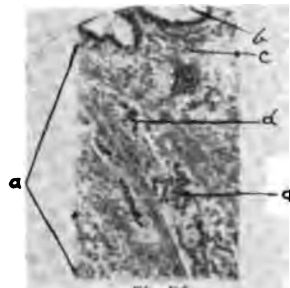

Fig. 96

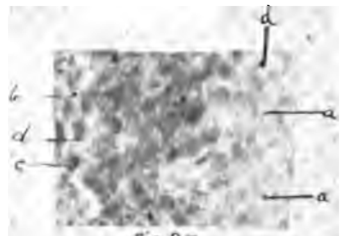

Fig. 97

Fig. 98

Fig. 99

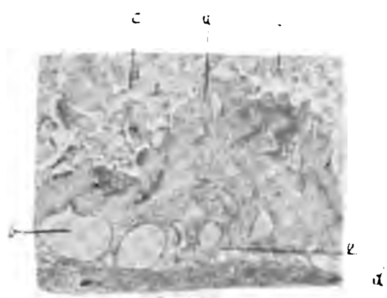

Fig. 100

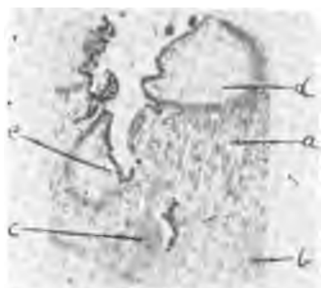

Fig. 101

Fig. 102

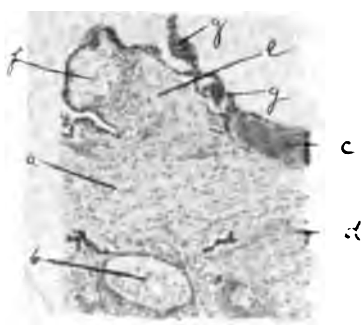

Fig. 103

PLATE XVI.

FIG. 104.—SECTION FROM FOUR-MONTH PREGNANCY SPECIMEN.

a, hyaline degeneration at surface of decidua; *b*, irregular plasmodial mass extending into decidua; *c*, small capillary; *d*, villus attached to decidua; *e*, irregular strand of syncytium extending into decidua. X. 40.

FIG. 105.—ANOTHER FROM THE SAME.

a, decidual cells of serotina; *b*, syncytial mass in decidua; *c*, gland-space. X. 40

FIG. 106.—ANOTHER FROM THE SAME.

a, decidual tissue of spongy layer; *b*, muscular part of uterine wall; *c*, large gland space into which blood has found its way; *d*, syncytial mass in decidua. X. 40.

FIG. 107.—ANOTHER FROM THE SAME.

a, muscular wall just below decidua; *b*, plasmodial mass which has penetrated muscle. X. 40.

FIG. 108.—SECTION OF SEROTINA FROM SIX-MONTH PREGNANT UTERUS.

a, compact layer of decidua; *b*, spongy layer; *c*, muscle; *d*, portions of villi attached to decidua. X. 25.

FIG. 109.—ANOTHER FROM THE SAME.

a, compact layer of decidua; *b*, spongy layer; *c*, muscle of wall; *d*, villi; *e*, hyaline degeneration in decidua; *f*, gland space X. 25.

FIG. 110.—ANOTHER FROM THE SAME.

a, decidual cells of compact layer; *b*, degenerated decidual tissue; *c*, branching villus; *d*, part of large villus embedded in decidua; *e*, syncytium on surface; *f*, blood-sinus in decidua. X. 40.

FIG. 111.—ANOTHER SECTION FROM SIX-MONTH PREGNANT UTERUS.

a, compact layer of decidua serotina; *b*, spongy layer; *c*, decidual hillock. X. 20.

PLATE XI.

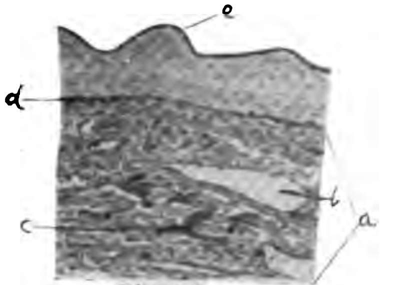

Fig. 66

Fig. 67

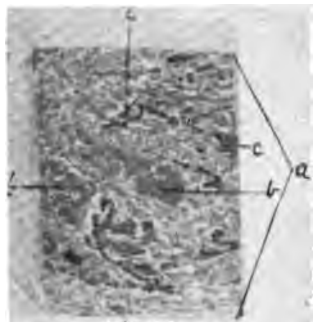

Fig. 68

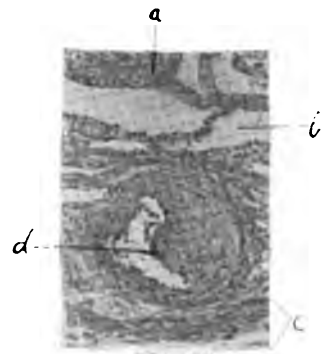

Fig. 69

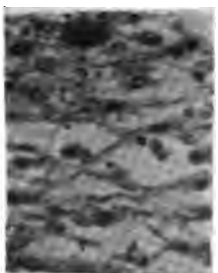

Fig. 70

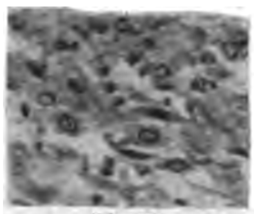

Fig. 71

Fig. 72

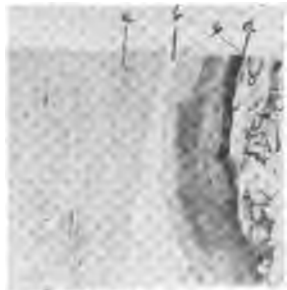

Fig. 73

PLATE XVII.

FIG. 112.—SECTION FROM SIX-MONTH PREGNANT UTERUS.

a, large decidual cells of serotina; *b*, elongated cells, loosely arranged; *c*, degenerated patch in decidua, structureless; *d*, villi; *e*, capillary. X. 40.

FIG. 113.—ANOTHER FROM THE SAME.

a, decidual cell of serotina; *b*, vacuolated condition of blended cell-substances; *c*, syncytial mass on surface; it is extending into decidua at one point. X. 300.

FIG. 114.—ANOTHER FROM THE SAME.

a, decidual tissue; *b*, large irregular crumpled mass of syncytium stripped somewhat from surface of decidua. X. 300.

FIG. 115.—ANOTHER FROM THE SAME.

a, structureless, degenerated decidua; *b*, broken-up tissue, cells degenerating. X. 300.

FIG. 116.—SECTION OF SEROTINA FROM FULL-TIME UTERUS.

a, decidua; note thinness of layer; *b*, muscular part of uterine wall; *c*, gland-space close to muscle; *d*, villi. X. 80.

FIG. 117.—ANOTHER FROM SAME.

a, large decidual cells of serotina; *b*, dense hyaline-like tissue with remains of nuclei; *c*, darkly stained layed of hyaline degeneration in decidua; *d*, delicate trabecula of spongy layer; *e*, muscle of uterine wall; *f*, villi; *g*, plasmodial mass on decidua; *h*, hyaline degeneration in connective tissue of villus attached to the decidual hillock. X. 80.

FIG. 118.—ANOTHER FROM SAME.

a, decidua; *b*, muscular part of wall; *c*, villi. X. 25.

FIG. 119.—ANOTHER SECTION FROM FULL-TIME SPECIMEN.

a, compact layer of serotina; *b*, hyaline degeneration at surface of decidua; *c*, junction of decidua and muscle; *d*, large sinus in decidua; in it are a few small pieces of plasmodium; *e*, muscle; *f*, villi of placenta; *g*, gland-space lined with low epithelium; *h*, large gland-space containing degenerated epithelium and blood. X. 80.

PLATE XII.

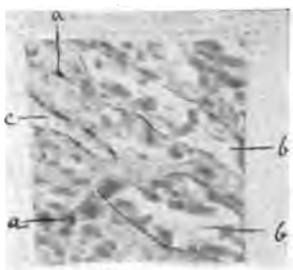

Fig. 74

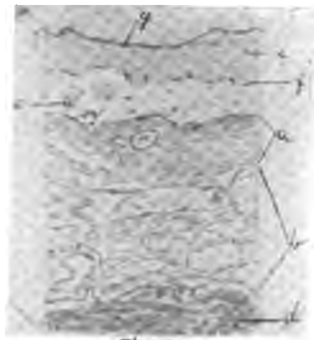

Fig. 75

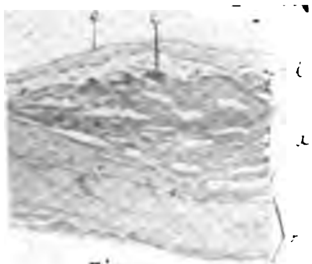

Fig. 76

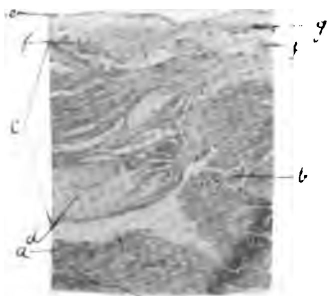

Fig. 77

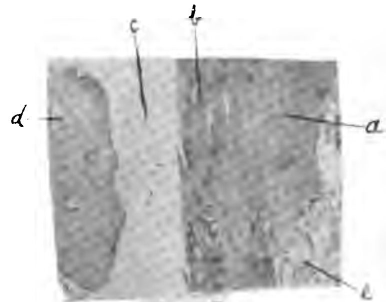

Fig. 78

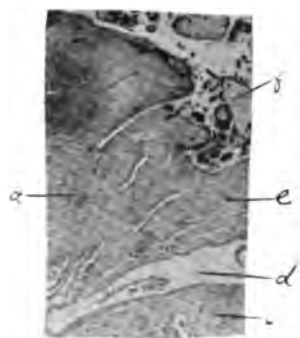

Fig. 79

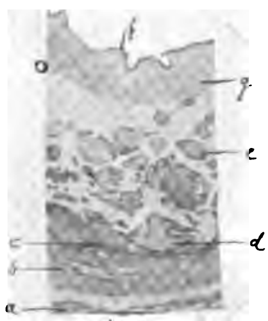

Fig. 80

PLATE XVIII.

FIG. 120.—SECTION FROM FULL-TIME PREGNANT UTERUS.

a, serotina; *b*, decidual hillock with villi attached; *c*, villi; *d*, remains of plasmodial layer on surface; *e*, blood-sinus of decidua communicating with intervillous space; masses of syncytium are attached to the wall. X. 80.

FIG. 121.—ANOTHER FROM THE SAME.

a, hyaline degeneration in serotina; *b*, degenerating decidual tissue; *c*, blood-vessel; *d*, villus stem attached to decidua; its core appears to be continuous with decidual tissue; *e*, villus attached to decidua; hyaline degeneration is extending into it; *f*, remains of syncytium; *g*, mass of fibrin attached to villus. X. 80.

FIG. 122.—ANOTHER FROM THE SAME.

a, hyaline degeneration in serotina; b, partial degeneration; some nuclei are still seen; *c*, small mass of syncytium; *d*, syncytial mass on surface; *e*, villus. X. 80.

FIG. 123.—ANOTHER SECTION OF SAME.

a, degenerated serotina; *b*, villus, attached to decidua. X. 80.

FIG. 124.—ANOTHER FROM THE SAME.

a, serotina; *b*, muscle of uterus; *c*, villi of placenta. X. 20

FIG. 125.—ANOTHER FROM THE SAME.

a, serotina; *b*, muscle of uterine wall; *c*, villi. X. 20.

FIG. 126.—ANOTHER FROM THE SAME.

a, serotina; *b*, muscle; *c*, villi. X. 20.

FIG. 127.—ANOTHER FROM THE SAME.

a, compact layer of serotina; *b*, spongy layer; *c*, muscle; *d*, decidual hillock; *e*, villi. X. 20.

PLATE XIII.

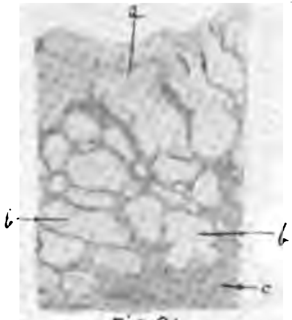

Fig. 81.

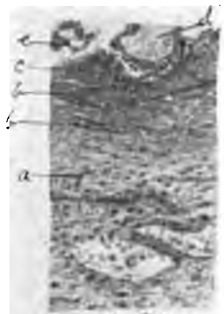

Fig. 82

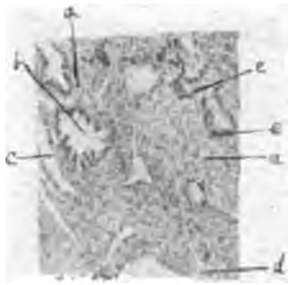

Fig. 83

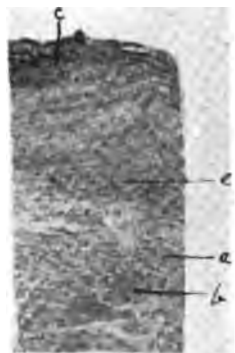

Fig. 84

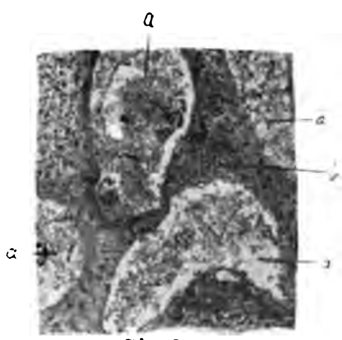

Fig. 85

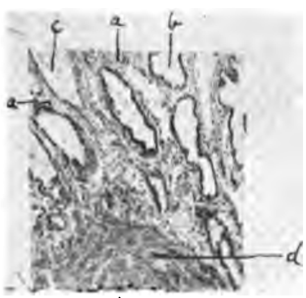

Fig. 86

Fig. 87

PLATE XIV.

FIG. 88.—SECTION FROM SIX-WEEK PREGNANCY.

a, decidual tissue of serotina: *b*, villus stem; *c*, plasmodial mass: *d*, irregular plasmodial mass on surface of decidua; *e*, irregular reticulated plasmodial mass. X. 80.

FIG. 89.—ANOTHER FROM THE SAME.

a, hyaline degeneration at surface: *b*, decidual tissue of serotina; *c*, degenerating decidual tissue: *d*, villus attached to decidua. X. 80.

FIG. 90.—ANOTHER FROM THE SAME.

a, decidual tissue of serotina: *b*, hyaline degeneration at surface; *c*, nucleated plasmodial mass: *d*, sinus communicating with intervillous space, extending towards surface: *e*, villus. X. 80.

FIG. 91.—ANOTHER FROM THE SAME.

a, decidual cells of serotina: *b*, capillary; *c*, villus attached to serotina by great proliferation of *Zell-schicht; d*, plasmodial mass on decidual surface; *e*, plasmodial mass in substance of substance of decidua. X. 80.

FIG. 92.—ANOTHER FROM THE SAME.

a, decidual cells; *b*, blood sinus; *c*, villus with stalk of plasmodium at end; *d*, mass of plasmodium on surface of decidual hillock; *e*, plasmodial mass in the substance of decidual hillock: *f*, another in the decidua: *g*, a large irregular plasmodial mass at surface of decidua. The decidua near it has an eroded appearance as if being absorbed. X. 80.

FIG. 93.—ANOTHER FROM THE SAME.

a, decidual tissue; *b*, sinus near surface: at its left side it communicates with the inter-villus space: plasmodial masses extend between its outer wall and the surface of the decidua; *c*, villus: *d*, end of villus attached to serotina by proliferated *Zell-schicht; e*, irregular plasmodial mass on surface of decidua. X. 80.

FIG. 94.—ANOTHER FROM THE SAME.

a, decidual cells of serotina: *b*, hyaline degeneration of decidua; *c*, villus: *d*, remains of gland-space. X. 80.

FIG. 95.—ANOTHER FROM THE SAME.

a, decidual cells of serotina; *b*, hyaline degeneration; *c*, nucleated plasmodial mass on surface of decidua: *d*, mass of plasmodium extending into decidua. X. 80.

PLATE XIV.

Fig. 88

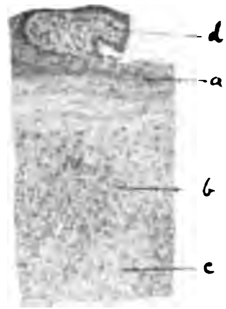

Fig. 89

Fig. 90

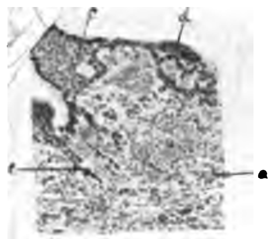

Fig. 91

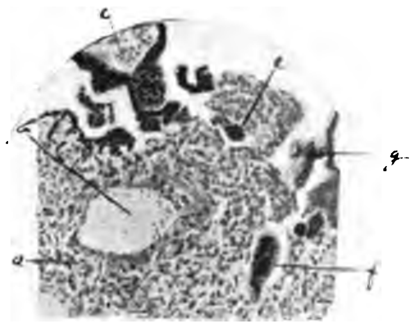

Fig. 92

Fig. 93

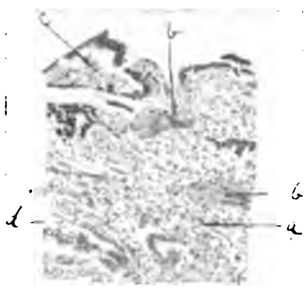

Fig. 94

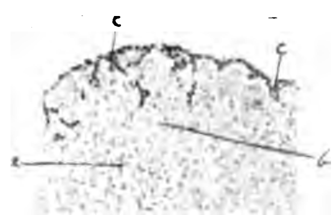

Fig. 95

PLATE XV.

FIG. 96.—ANOTHER SECTION FROM SIX-WEEK PREGNANT UTERUS.

a, muscular part of uterine wall; *b*, gland-space at junction of spongy and muscular layers; *c*, decidual cells below the level of the glands; *d*, mass of plasmodium extending between the muscular bundles. X. 80.

FIG. 97.—ANOTHER FROM THE SAME.

a, faintly staining degenerated decidua: it has a cheesy appearance, the cell outlines are largely lost and few nuclei are visible; *b*, darkly staining patch of the same; *c*, cell nucleus; *d*, leucocyte. X. 290.

FIG. 98.—ANOTHER FROM THE SAME.

a, decidual cells near the surface of the compact layer: they are irregular in shape and the nuclei stain deeply; *b*, mass of syncytium extending into the decidua. X. 300.

FIG. 99.—SECTION OF SEROTINA FROM A FOUR-MONTH PREGNANT UTERUS.

a, compact layer; note irregularity of surface; *b*, spongy layer; *c*, muscular part of uterine wall; *d*, villi. X. 25.

FIG. 100.—ANOTHER FROM THE SAME.

a, decidual hillock; *b*, blood sinus; *c*, villi; *d*, muscle of uterine wall; *e*, spongy part of decidua. X. 25.

FIG. 101.—ANOTHER FROM THE SAME.

a, decidual cells of serotina; *b*, degenerating cells; *c*, patch of hyaline degeneration; *d*, villus attached by proliferation of *Zell-schicht*; *e*, villus somewhat embedded in surface. X. 40.

FIG. 102.—ANOTHER FROM THE SAME.

a, decidual hillock; *b*, villus attached to decidua at two points; *c*, villus attached by proliferation of *Zell-schicht*; *d*, mass of syncytium. X. 40.

FIG. 103.—ANOTHER FROM THE SAME.

a, compact layer of decidua: note chain-like rows of cells; *b*, blood-sinus; *c*, hyaline degeneration at surface; *d*, hyaline degeneration in compact layer; *e*, decidual hillock; *f*, attached villus; *g*, irregular mass of syncytium on surface of decidua. X. 40.

PLATE XX.

Fig. 136

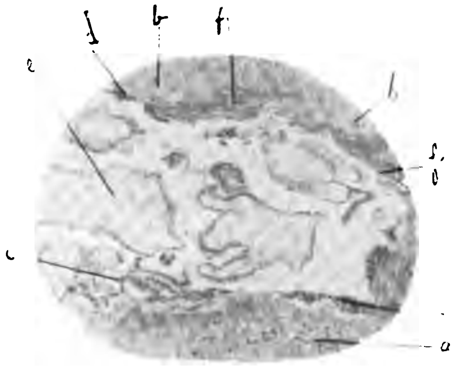

Fig. 137

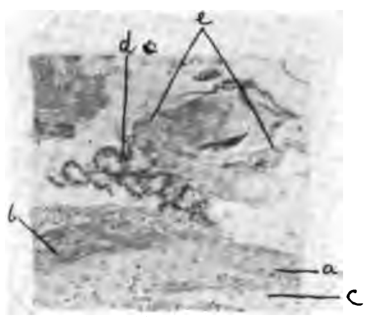

Fig. 138

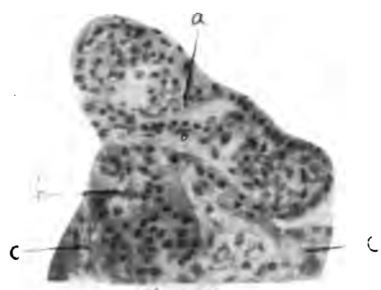

Fig. 139

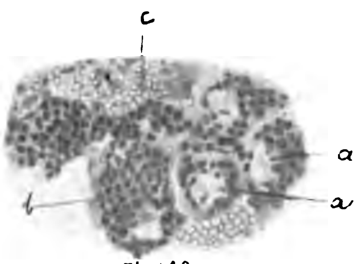

Fig. 140

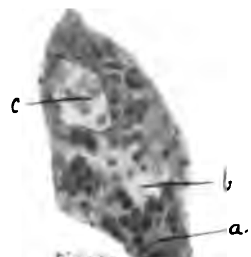

Fig. 141

Fig. 142

Fig 143

PLATE XVI.

FIG. 104.—SECTION FROM FOUR-MONTH PREGNANCY SPECIMEN.

a, hyaline degeneration at surface of decidua; *b*, irregular plasmodial mass extending into decidua; *c*, small capillary; *d*, villus attached to decidua; *e*, irregular strand of syncytium extending into decidua. X. 40.

FIG. 105.—ANOTHER FROM THE SAME.

a, decidual cells of serotina; *b*, syncytial mass in decidua; *c*, gland-space. X. 40

FIG. 106.—ANOTHER FROM THE SAME.

a, decidual tissue of spongy layer; *b*, muscular part of uterine wall; *c*, large gland space into which blood has found its way; *d*, syncytial mass in decidua. X. 40.

FIG. 107.—ANOTHER FROM THE SAME.

a, muscular wall just below decidua; *b*, plasmodial mass which has penetrated muscle. X. 40.

FIG. 108.—SECTION OF SEROTINA FROM SIX-MONTH PREGNANT UTERUS.

a, compact layer of decidua; *b*, spongy layer; *c*, muscle; *d*, portions of villi attached to decidua. X. 25.

FIG. 109.—ANOTHER FROM THE SAME.

a, compact layer of decidua; *b*, spongy layer; *c*, muscle of wall; *d*, villi; *e*, hyaline degeneration in decidua; *f*, gland space X. 25.

FIG. 110.—ANOTHER FROM THE SAME.

a, decidual cells of compact layer; *b*, degenerated decidual tissue; *c*, branching villus; *d*, part of large villus embedded in decidua; *e*, syncytium on surface; *f*, blood-sinus in decidua. X. 40.

FIG. 111.—ANOTHER SECTION FROM SIX-MONTH PREGNANT UTERUS.

a, compact layer of decidua serotina; *b*, spongy layer; *c*, decidual hillock. X. 20.

PLATE XXI.

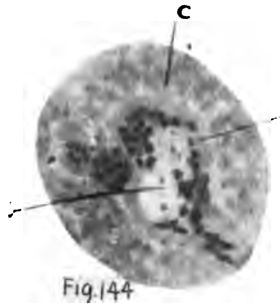

Fig.144

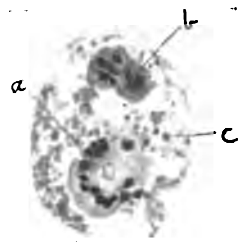

Fig. 145

Fig 146

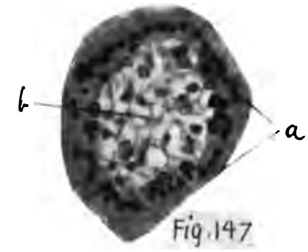

Fig.147

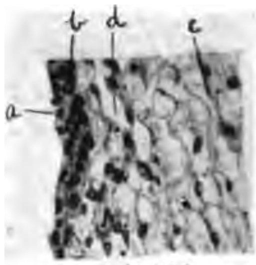

Fig. 148

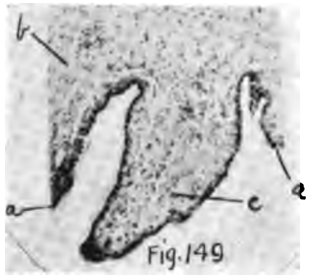

Fig.149

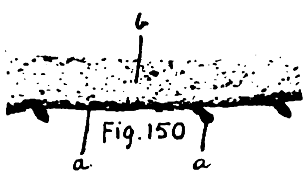

Fig.150

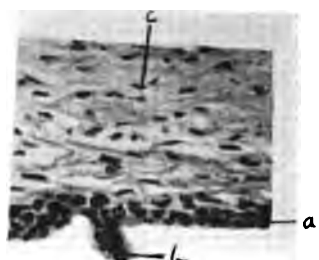

Fig. 151

PLATE XVII.

FIG. 112.—SECTION FROM SIX-MONTH PREGNANT UTERUS.

a, large decidual cells of serotina; *b*, elongated cells, loosely arranged; *c*, degenerated patch in decidua, structureless; *d*, villi; *e*, capillary. X. 40.

FIG. 113.—ANOTHER FROM THE SAME.

a, decidual cell of serotina: *b*. vacuolated condition of blended cell-substances: c, syncytial mass on surface: it is extending into decidua at one point. X. 300.

FIG. 114.—ANOTHER FROM THE SAME.

a, decidual tissue; *b*. large irregular crumpled mass of syncytium stripped somewhat from surface of decidua. X. 300.

FIG. 115.—ANOTHER FROM THE SAME.

a, structureless, degenerated decidua: *b*, broken-up tissue, cells degenerating. X. 300.

FIG. 116.—SECTION OF SEROTINA FROM FULL-TIME UTERUS.

a, decidua; note thinness of layer; *b*, muscular part of uterine wall; *c*, gland-space close to muscle; *d*, villi. X. 80.

FIG. 117.—ANOTHER FROM SAME.

a, large decidual cells of serotina: *b*, dense hyaline-like tissue with remains of nuclei: *c*, darkly stained layed of hyaline degeneration in decidua; *d*, delicate trabecula of spongy layer; *e*, muscle of uterine wall: *f*, villi: *g*. plasmodial mass on decidua; *h*. hyaline degeneration in connective tissue of villus attached to the decidual hillock. X. 80.

FIG. 118.—ANOTHER FROM SAME.

a, decidua; *b*. muscular part of wall: *c*, villi. X. 25.

FIG. 119.—ANOTHER SECTION FROM FULL-TIME SPECIMEN.

a, compact layer of serotina; *b*, hyaline degeneration at surface of decidua: *c*, junction of decidua and muscle; *d*, large sinus in decidua; in it are a few small pieces of plasmodium: *e*, muscle: *f*, villi of placenta: *g*, gland-space lined with low epithelium: *h*, large gland-space containing degenerated epithelium and blood. X. 80.

PLATE XVII.

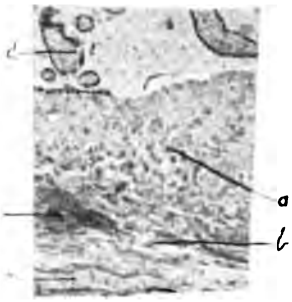

Fig. 112

Fig. 113

Fig. 114

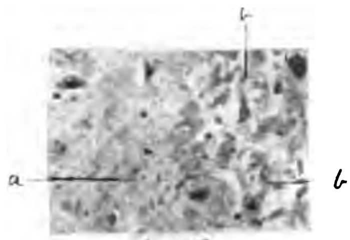

Fig 115

Fig. 116

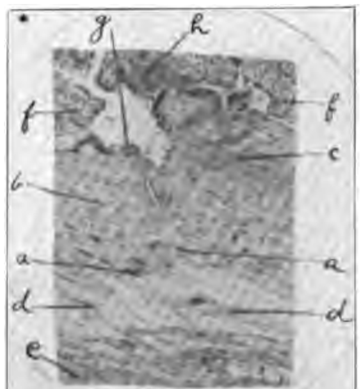

Fig 117

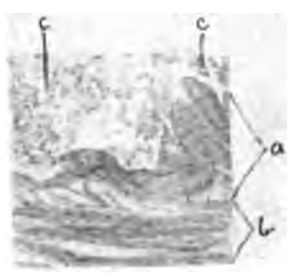

Fig. 118

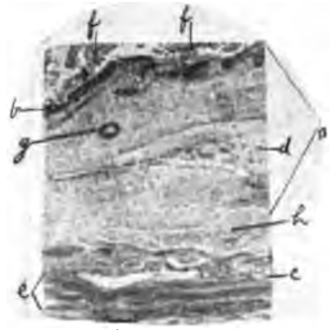

Fig 119

PLATE XXIII.

FIG. 159.- SECTION FROM SIX-WEEK PREGNANT UTERUS.

a, decidual hillock of serotina: *b*, plasmodium on surface of decidua: *c*, blood sinus in hillock: *d*, villus attached by proliferation of epithelium, to decidual hillock. X. 80.

FIG. 160 ANOTHER SECTION FROM SAME.

a, serotina: *b*, hyaline degeneration in serotina: *c*, villus attached to serotina: *d*, small amount of proliferation of epithelium of villus: *e*, villus. X. 80.

FIG. 161. – SECTION FROM SPECIMEN OF A FOUR-MONTH PREGNANCY.

a, connective tissue of chorion: *b*, chorionic epithelium degenerating in parts: *c*, delicate connective tissue between amnion and chorion: *d*, amnion. X. 80.

FIG. 162.– ANOTHER FROM SAME.

a, chorionic epithelium, degenerating in parts: *b*, line of junction of chorion and amnion: *c*, amniotic epithelium. X. 80.

FIG. 163.- -ANOTHER FROM SAME.

a, chorionic epithelium, somewhat degenerated: *b*, connective tissue of chorion. X. 290.

FIG. 164. -ANOTHER FROM SAME.

a, hillock of serotina: *b*, villus stem attached: *c*, small villus: *d*, syncytium in decidua. X. 80.

FIG. 165.--ANOTHER FROM SAME.

a, villus: *b*, capillary of villus: note the condensed tissue around it: *c*, blood in inter-villous space. X. 80.

FIG. 166. —ANOTHER FROM SAME.

a, connective tissue of large villus: *b*, condensed tissue around capillary: *c*, blood in inter-villous space. X. 80.

PLATE XXIII.

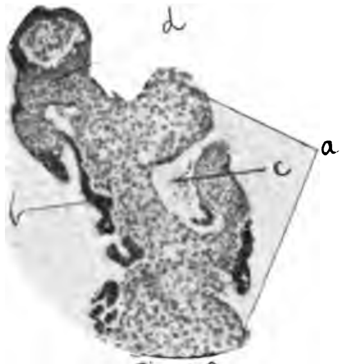

Fig. 159

Fig. 160

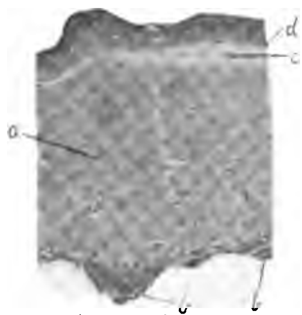

Fig. 161

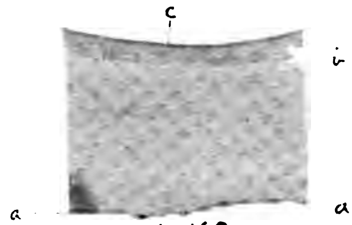

Fig. 162

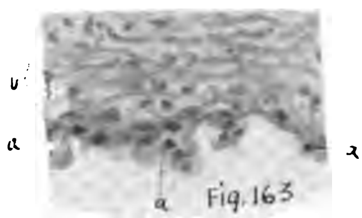

Fig. 163

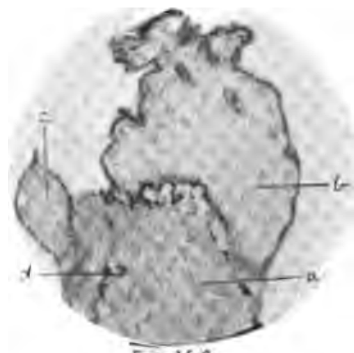

Fig. 164

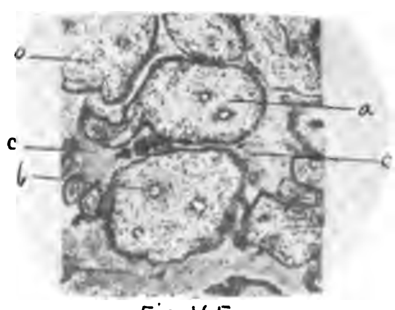

Fig. 165

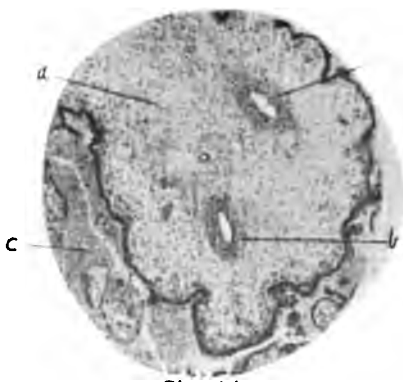

Fig. 166

PLATE XXIV.

FIG. 167.—SECTION FROM FOUR-MONTH PREGNANT UTERUS.

Sections of villi: note the variations in the thickness of the covering epithelium. X. 80.

FIG. 168.—SECTION FROM SIX-MONTH PREGNANT UTERUS.

a, amnion, somewhat folded: *b*, chorion; *c*, chorionic epithelium; *d*, amniotic epithelium. X. 80.

FIG. 169.—ANOTHER FROM SAME.

a, epithelium of chorion: *b*, connective tissue of chorion: *c*, strand between amnion and chorion; *d*, amniotic connective tissue; *e*, epithelium of amnion. X. 80

FIG. 170.—ANOTHER FROM SAME.

a, connective tissue of chorion: *b*, proliferated inner wall of vessel of chorion; *c*, lumen of vessel; *d*, chorionic epithelium. X. 300.

FIG. 171.—SECTION FROM FULL-TIME SPECIMEN.

a, outer plasmodial layer of chorion: it is very patchy; *b*, connective tissue of chorion; *c*, vessel; *d*, villus. X. 80.

FIG. 172.—SECTION FROM SIX-MONTH SPECIMEN.

a, outer layer of chorionic epithelium; *b*, inner layer; *c*, connective tissue. Note the degeneration in the epithelium. X. 300.

FIG. 173.—ANOTHER FROM SAME.

a, connective tissue of chorion; *b*, deep layer of epithelium; *c*, outer or syncytial layer of epithelium; *d*, syncytial bud. X. 300.

PLATE XXIV.

Fig. 167

Fig 168

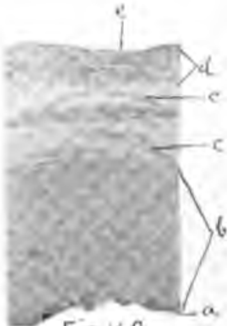

Fig 169

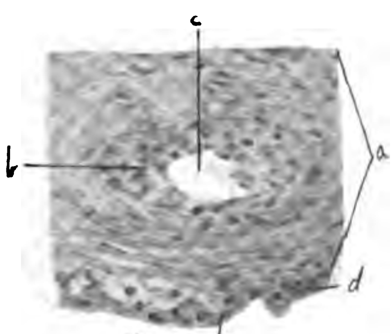

Fig. 170

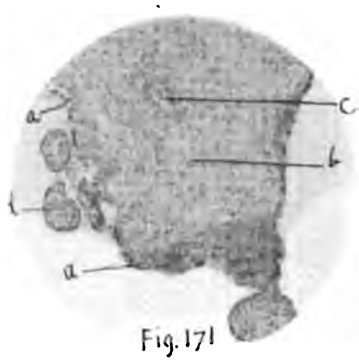

Fig. 171

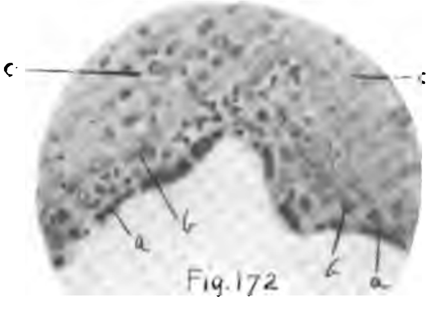

Fig. 172

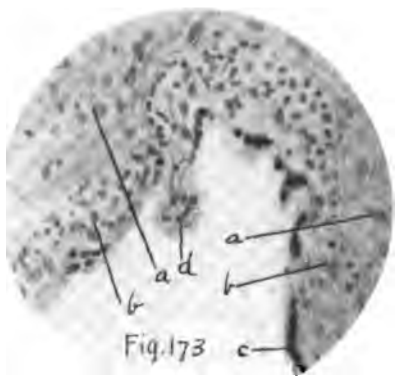

Fig. 173

PLATE XXV.

FIG. 174.—SECTION FROM SIX-MONTH SPECIMEN.

a, chorionic connective tissue; *b*, deep layer of epithelium, somewhat degenerated and invaded by leucocytes; *c*, superficial layer, considerably broken up; *d*, thick deposit of fibrin on epithelium; *e*, blood of intervillous space. X. 300.

FIG. 175.—ANOTHER FROM THE SAME.

a, chorionic connective tissue; *b*, degenerated deep layer of epithelium; *c*, hyaline degeneration; *d*, remains of superficial layer of epithelium. X. 300.

FIG. 176.—ANOTHER SECTION FROM SIX-MONTH SPECIMEN.

a, epithelium of villus: it is mainly syncytial and not very thick; *b*, capillary. X. 300.

FIG. 177.—ANOTHER FROM THE SAME.

a, villus stem attached to serotina and somewhat embedded in it; *b*, embedded end of villus; *c*, some proliferation of epithelium; *d*, connective tissue of villus, without any covering epithelium; *e*, serotina; *f*, hyaline degeneration. X. 80.

FIG. 178.—ANOTHER FROM THE SAME.

a, connective tissue of large villus stem; *b*, artery; *c*, epithelial covering, very thin, mainly syncytial; *d*, branch-villus. X. 80.

FIG. 179.—SECTION FROM FULL-TIME SPECIMEN.

a, epithelium of chorion, degenerated and split up; *b*, chorionic connective tissue; *c*, amnion; *d*, epithelium of amnion; *e*, villi. X. 80

FIG. 180.—ANOTHER FROM THE SAME.

a, epithelium of amnion; the cells are columnar here; *b*, connective tissue of amnion; *c*, delicate strands between amnion and chorion. X. 80.

FIG. 181.—ANOTHER FROM THE SAME.

a, columnar epithelial cells of amnion; *b*, connective tissue. X. 300.

PLATE XX.

Fig. 136

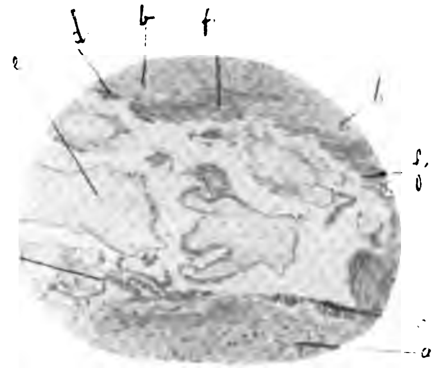

Fig. 137

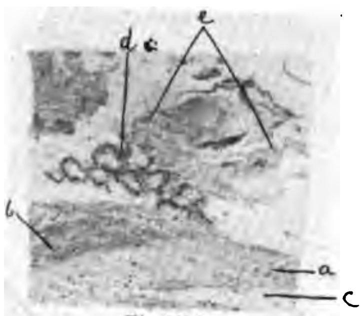

Fig. 138

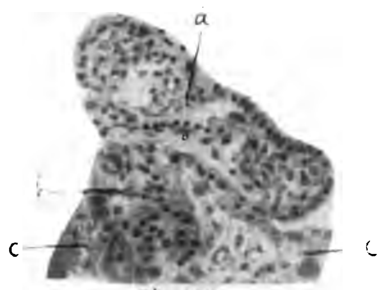

Fig. 139

Fig. 140

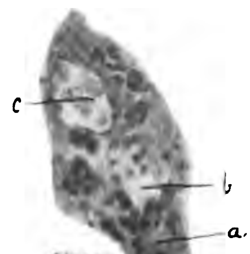

Fig. 141

Fig. 142

Fig. 143

PLATE XXI.

FIG. 144.—SECTION FROM FIVE-WEEK PREGNANCY.

a, early villus; *b*, central vacuole, containing early mesoblast: *c*, maternal blood. X. 290.

FIG. 145.—ANOTHER FROM SAME.

a, early villus; *b*, plasmodial mass: *c*, blood around villi. X. 290

FIG. 146.—ANOTHER FROM SAME.

a, outer or syncytial layer of villus: *b*, deeper layer, or Langhans' *Zellschicht*: *c*, mesoblastic core; *d*, capillary of villus. X. 290.

FIG. 147.—ANOTHER FROM SAME.

a, epithelial covering of villus: note that the deeper layer is very slightly marked; *b*, mesoblastic core. X. 290.

FIG. 148.—ANOTHER FROM SAME.

a, outer, or syncytial layer of epithelium of large villus-stem; *b*, inner or Langhans layer; *c*, mesoblastic tissue; *d*, capillary. X. 290.

FIG. 149.—SECTION FROM SIX-WEEK PREGNANT UTERUS.

a, chorionic epithelium; *b*, connective tissue of chorion; *c*, villus-stem cut obliquely. X. 80.

FIG. 150.—ANOTHER FROM SAME.

a, chorionic epithelium; *b*, chorionic connective tissue. X. 80

FIG. 151.—ANOTHER FROM SAME.

a, chorionic epithelium; *b*, bud projecting from surface; *c*, connective tissue of chorion. X. 300.

PLATE XXI.

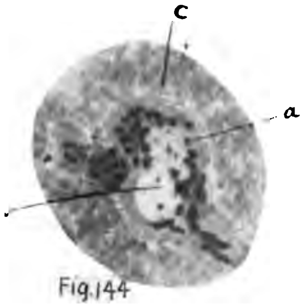

Fig. 144

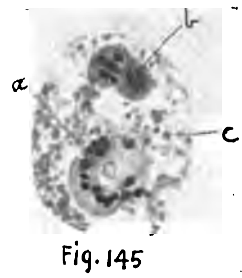

Fig. 145

Fig. 146

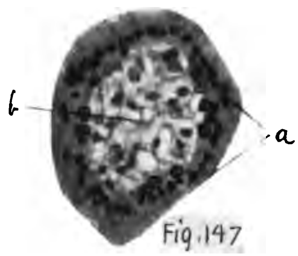

Fig. 147

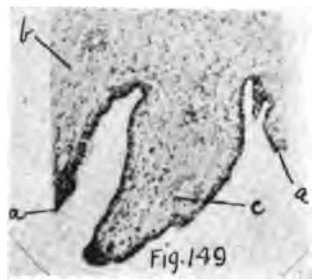

Fig. 149

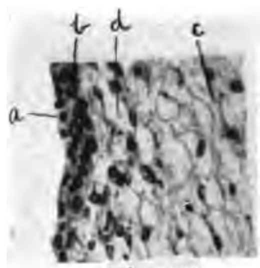

Fig. 148

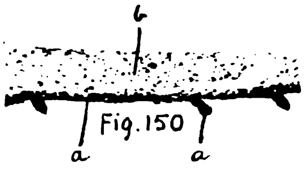

Fig. 150

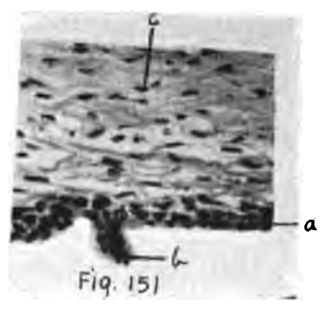

Fig. 151

PLATE XXII.

FIG. 152.—ANOTHER SECTION FROM SIX-WEEK PREGNANT UTERUS.

a, chorionic epithelium: note the well-marked outer plasmodial layer and the small number of cells in the deep layer; *b*, connective tissue; some cells appear to be arranged as a basement membrane under the epithelium. X. 300.

FIG. 153.—ANOTHER FROM SAME.

a, amniotic epithelium; *b*, connective tissue of amnion. X. 300.

FIG. 154.—ANOTHER FROM SAME.

a, villus-stem; *b*, small plasmodial mass among villi; *c*, early villus; *d*, maternal blood. X. 80

FIG. 155.—ANOTHER FROM SAME.

a, villus; *b*, early villus with strand of syncytium. X. 80.

FIG. 156.—ANOTHER FROM SAME.

a, serotina; *b*, syncytial mass on surface; *c*, decidual hillock; *d*, proliferated deep, or Langhans' layer of epithelium at end of villus; *e*, syncytium extending into decidua. X. 80.

FIG. 157.—ANOTHER FROM SAME.

a, serotina; *b*, plasmodial mass on surface; *c*, proliferated Langhans layer of epithelium of villus. X. 80.

FIG. 158.—ANOTHER FROM SAME.

a, remains of gland in serotina; *b*, serotina; *c*, syncytium on surface; *d*, connective tissue of villus; *e*, proliferated deep layer of epithelium covering villus; *f*, large decidual cells. X. 80.

PLATE XXII.

Fig. 152

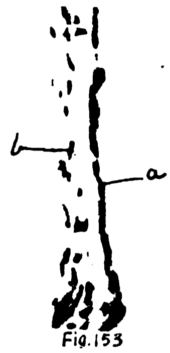

Fig. 153

Fig. 154

Fig. 155

Fig. 156

Fig. 157

Fig. 158

PLATE XXIII.

FIG. 159.—SECTION FROM SIX-WEEK PREGNANT UTERUS.

a, decidual hillock of serotina; *b*, plasmodium on surface of decidua; *c*, blood sinus in hillock; *d*, villus attached by proliferation of epithelium, to decidual hillock. X. 80.

FIG. 160 ANOTHER SECTION FROM SAME.

a, serotina; *b*, hyaline degeneration in serotina; *c*, villus attached to serotina; *d*, small amount of proliferation of epithelium of villus; *e*, villus. X. 80.

FIG. 161.—SECTION FROM SPECIMEN OF A FOUR-MONTH PREGNANCY.

a, connective tissue of chorion; *b*, chorionic epithelium degenerating in parts; *c*, delicate connective tissue between amnion and chorion; *d*, amnion. X. 80.

FIG. 162.—ANOTHER FROM SAME.

a, chorionic epithelium, degenerating in parts; *b*, line of junction of chorion and amnion; *c*, amniotic epithelium. X. 80.

FIG. 163.—ANOTHER FROM SAME.

a, chorionic epithelium, somewhat degenerated; *b*, connective tissue of chorion. X. 290.

FIG. 164.—ANOTHER FROM SAME.

a, hillock of serotina; *b*, villus stem attached; *c*, small villus; *d*, syncytium in decidua. X. 80.

FIG. 165.—ANOTHER FROM SAME.

a, villus; *b*, capillary of villus; note the condensed tissue around it; *c*, blood in inter-villous space. X. 80.

FIG. 166.—ANOTHER FROM SAME.

a, connective tissue of large villus; *b*, condensed tissue around capillary; *c*, blood in inter-villous space. X. 80.

PLATE XXIII.

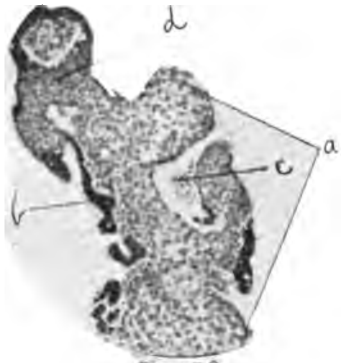

Fig. 159

Fig. 160

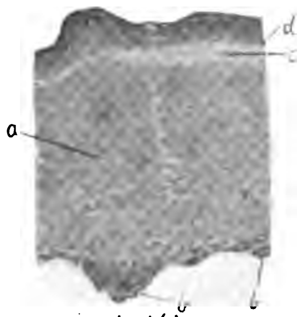

Fig. 161

Fig. 162

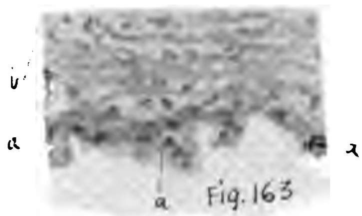

Fig. 163

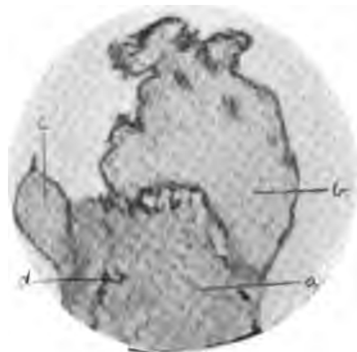

Fig. 164

Fig. 165

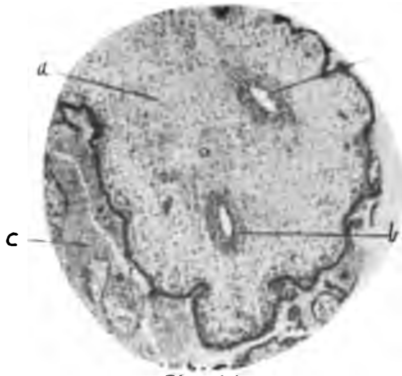

Fig. 166

PLATE XXIV.

FIG. 167.—SECTION FROM FOUR-MONTH PREGNANT UTERUS.

Sections of villi: note the variations in the thickness of the covering epithelium. X. 80.

FIG. 168. – SECTION FROM SIX-MONTH PREGNANT UTERUS.

a, amnion, somewhat folded; *b*, chorion; *c*, chorionic epithelium; *d*, amniotic epithelium. X. 80.

FIG. 169.—ANOTHER FROM SAME.

a, epithelium of chorion; *b*, connective tissue of chorion: *c*, strand between amnion and chorion; *d*, amniotic connective tissue; *e*, epithelium of amnion. X. 80

FIG. 170.—ANOTHER FROM SAME.

a, connective tissue of chorion: *b*, proliferated inner wall of vessel of chorion; *c*, lumen of vessel; *d*, chorionic epithelium. X. 300.

FIG. 171.—SECTION FROM FULL-TIME SPECIMEN.

a, outer plasmodial layer of chorion; it is very patchy; *b*, connective tissue of chorion: *c*, vessel: *d*, villus. X. 80.

FIG. 172.—SECTION FROM SIX-MONTH SPECIMEN.

a, outer layer of chorionic epithelium; *b*, inner layer; *c*, connective tissue. Note the degeneration in the epithelium. X. 300.

FIG. 173.—ANOTHER FROM SAME.

a, connective tissue of chorion; *b*, deep layer of epithelium; *c*, outer or syncytial layer of epithelium; *d*, syncytial bud. X. 300.

PLATE XXIV.

Fig 167

Fig 168

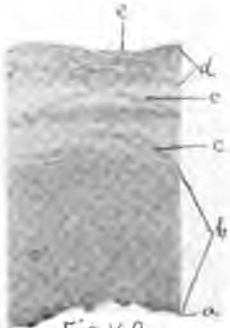

Fig 169

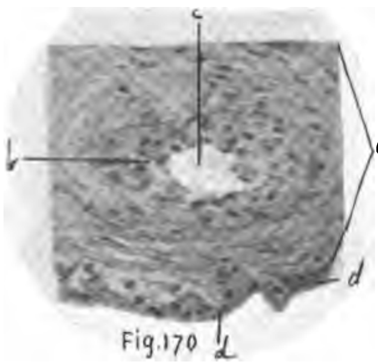

Fig. 170

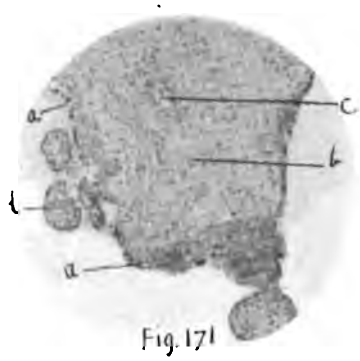

Fig. 171

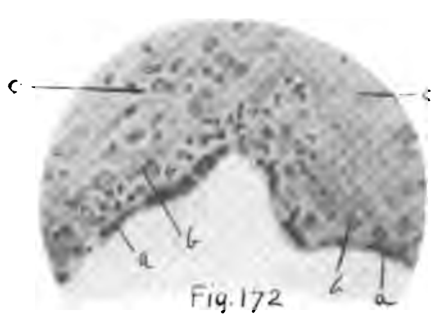

Fig. 172

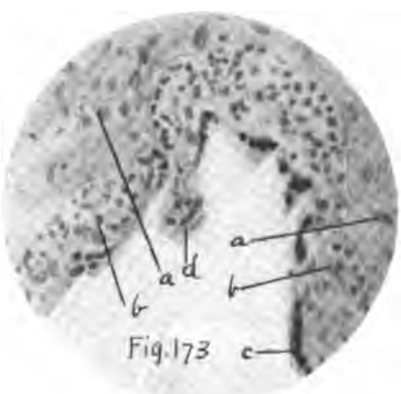

Fig. 173

PLATE XXV.

FIG. 174.—SECTION FROM SIX-MONTH SPECIMEN.

a, chorionic connective tissue; *b*, deep layer of epithelium, somewhat degenerated and invaded by leucocytes; *c*, superficial layer, considerably broken up; *d*, thick deposit of fibrin on epithelium; *e*, blood of intervillous space. X. 300.

FIG. 175.—ANOTHER FROM THE SAME.

a, chorionic connective tissue; *b*, degenerated deep layer of epithelium; *c*, hyaline degeneration; *d*, remains of superficial layer of epithelium. X. 300.

FIG. 176.—ANOTHER SECTION FROM SIX-MONTH SPECIMEN.

a, epithelium of villus; it is mainly syncytial and not very thick; *b*, capillary. X. 300.

FIG. 177.—ANOTHER FROM THE SAME.

a, villus stem attached to serotina and somewhat embedded in it; *b*, embedded end of villus; *c*, some proliferation of epithelium; *d*, connective tissue of villus, without any covering epithelium; *e*, serotina; *f*, hyaline degeneration. X. 80.

FIG. 178.—ANOTHER FROM THE SAME.

a, connective tissue of large villus stem; *b*, artery; *c*, epithelial covering, very thin, mainly syncytial; *d*, branch-villus. X. 80.

FIG. 179.—SECTION FROM FULL-TIME SPECIMEN.

a, epithelium of chorion, degenerated and split up; *b*, chorionic connective tissue; *c*, amnion; *d*, epithelium of amnion; *e*, villi. X. 80

FIG. 180.—ANOTHER FROM THE SAME.

a, epithelium of amnion; the cells are columnar here; *b*, connective tissue of amnion; *c*, delicate strands between amnion and chorion. X. 80.

FIG. 181.—ANOTHER FROM THE SAME.

a, columnar epithelial cells of amnion; *b*, connective tissue. X. 300.

PLATE XXV.

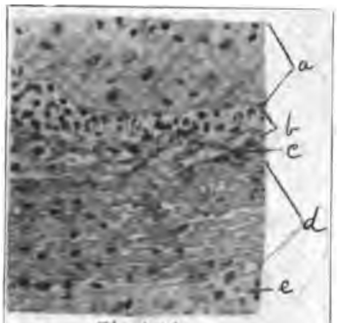

Fig 174

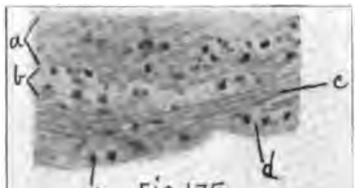

Fig. 175

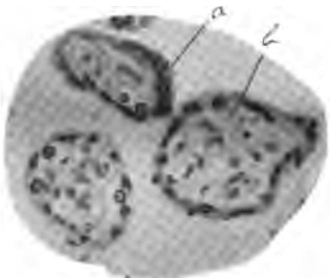

Fig. 176

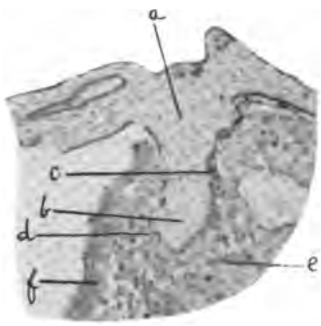

Fig. 177

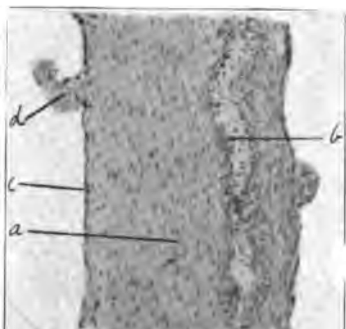

Fig. 178

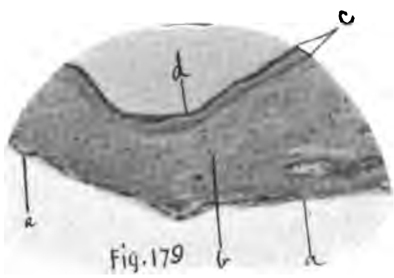

Fig. 179

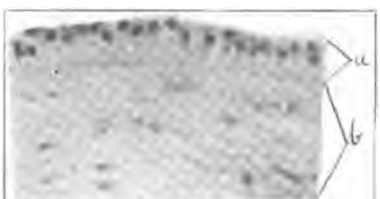

Fig. 181

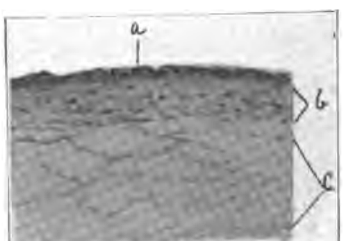

Fig. 180

PLATE XXVI.

FIG. 182.—SECTION FROM FULL-TIME SPECIMEN.

a, chorionic connective tissue; *b*, villus stem arising from chorion; *c*, patch of syncytium; note that in some parts the epithelium is quite absent. X. 80.

FIG. 183.—ANOTHER FROM THE SAME.

a, connective tissue of chorion; *b*, epithelium of chorion; *c*, epithelium absent; here is seen some hyaline degeneration entering into the connective tissue; *d*, branch-villus. X. 80.

FIG. 184.—ANOTHER SECTION FROM FULL-TIME SPECIMEN.

a, villus-stem; *b*, branch-villus; *c*, epithelium, mainly syncytium. Note variations in thickness of epithelium. In parts it is wanting. X. 80.

FIG. 185.—ANOTHER FROM THE SAME.

a, large villus-stem; *b*, epithelium, mainly syncytium; *c*, blood-vessel; *d*, branch-villus. X. 80.

FIG. 186.—ANOTHER FROM THE SAME.

Sections across villi. *a*, dilated capillaries. X. 80.

FIG. 187. ANOTHER FROM THE SAME.

a, epithelium covering villus; *b*, part of villus with no epithelium visible on it; *c*, dilated capillary; *d*, connective tissue. X. 300.

FIG. 188. ANOTHER FROM THE SAME.

a, connective tissue of villus; *b*, dilated capillary cut longitudinally; *c*, epithelial covering of villus. X. 300

FIG. 189.—ANOTHER FROM THE SAME.

a, connective tissue of villus; *b*, epithelium; *c*, dilated blood vessel. X. 300

PLATE XXVI.

FIG. 182.—SECTION FROM FULL-TIME SPECIMEN.

a, chorionic connective tissue; *b*, villus stem arising from chorion; *c*, patch of syncytium; note that in some parts the epithelium is quite absent. X. 80.

FIG. 183.—ANOTHER FROM THE SAME.

a, connective tissue of chorion; *b*, epithelium of chorion; *c*, epithelium absent; here is seen some hyaline degeneration entering into the connective tissue; *d*, branch-villus. X. 80.

FIG. 184.—ANOTHER SECTION FROM FULL-TIME SPECIMEN.

a, villus-stem; *b*, branch-villus; *c*, epithelium, mainly syncytium. Note variations in thickness of epithelium. In parts it is wanting. X. 80.

FIG. 185.—ANOTHER FROM THE SAME.

a, large villus-stem; *b*, epithelium, mainly syncytium; *c*, blood-vessel; *d*, branch-villus. X. 80.

FIG. 186.—ANOTHER FROM THE SAME.

Sections across villi. *a*, dilated capillaries. X. 80.

FIG. 187.—ANOTHER FROM THE SAME.

a, epithelium covering villus; *b*, part of villus with no epithelium visible on it; *c*, dilated capillary; *d*, connective tissue. X. 300.

FIG. 188.—ANOTHER FROM THE SAME.

a, connective tissue of villus; *b*, dilated capillary cut longitudinally; *c*, epithelial covering of villus. X. 300

FIG. 189.—ANOTHER FROM THE SAME.

a, connective tissue of villus; *b*, epithelium; *c*, dilated blood-vessel. X. 300

PLATE XXVI.

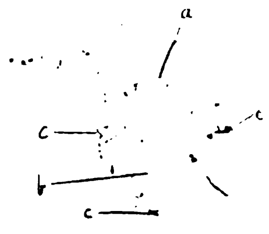

Fig. 182

Fig. 183

Fig. 184

Fig. 185

Fig. 186

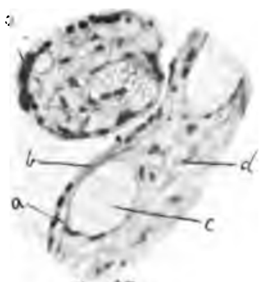

Fig. 187

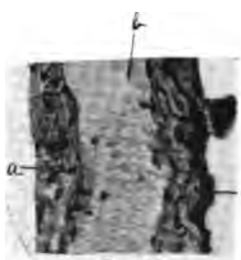

Fig. 188

Fig. 189

PLATE XXVII.

FIG. 190.—SECTION FROM FOUR-WEEK ABORTION.

a, surface of vera; *b*, compact layer of vera; *c*, gland-space; *d*, separation-plane through junction of compact and spongy layers and through outer part of latter. X. 25.

FIG. 191.—ANOTHER FROM THE SAME.

a, compact layer of serotina; *b*, spongy layer; *c*, separation-plane; *d*, villi in maternal blood; *e*, amnion; *f*, chorion. The amnion and chorion are separated from the villi. X. 25.

FIG. 192.—ANOTHER FROM THE SAME.

a, compact layer of serotina; *b*, tissue of spongy layer; *c*, separation-plane; *d*, villi and blood of intervillous space; *e*, chorion; *f*, amnion. X. 25.

FIG. 193.—ANOTHER FROM THE SAME.

a, compact layer of serotina; *b*, part of spongy layer; *c*, hyaline degeneration; *d*, separation-plane; *e*, villi. X. 25.

FIG. 194.—ANOTHER FROM THE SAME.

a, reflexa; *b*, vera; *c*, junction of vera and reflexa; d, separation-plane of vera through lower part of compact layer; *c*, villi. X. 25.

FIG. 195.—SECTION FROM SIX-WEEK ABORTION.

a, compact layer of serotina; *b*, separation-plane through outer part of spongy layer; *c*, separation-plane through compact layer; *d*, villi; *e*, hyaline degeneration. X. 25.

FIG. 196.—ANOTHER FROM THE SAME.

a, compact layer of serotina; *b*, separation-plane through compact layer; *c*, villi. X. 25.

FIG. 197.—SECTION OF PLACENTA OF FOUR-MONTH ABORTION.

a, outer part of decidua serotina; *b*, decidual hillock; *c*, separation-plane through compact layer; *d*, villi. X. 25.

PLATE XXVII.

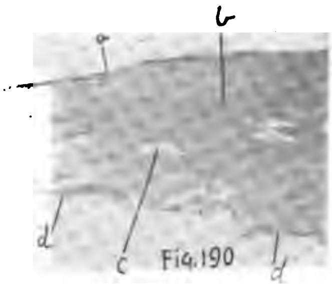

Fig. 190

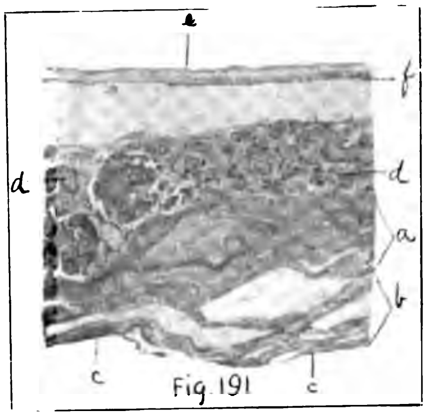

Fig. 191

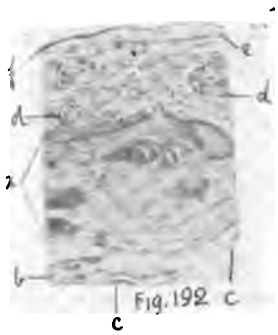

Fig. 192

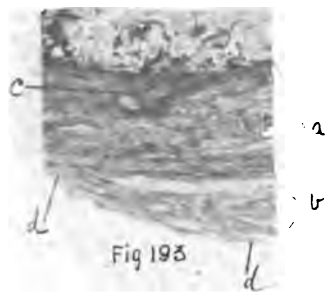

Fig. 193

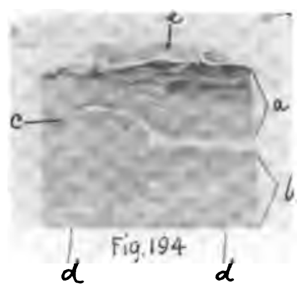

Fig. 194

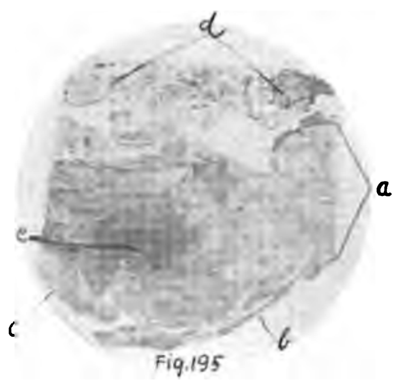

Fig. 195

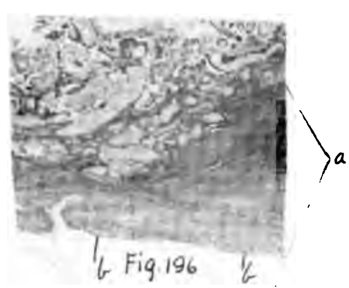

Fig. 196

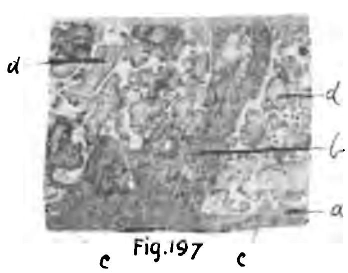

Fig. 197

PLATE XXVIII.

FIG. 198.—SECTION FROM FOUR-MONTH COMPLETE ABORTION.

a, layer of serotina on placenta; *b*, decidual hillock; *c*, separation-plane through junction of compact and spongy layer; *d*, villi. X. 25.

FIG. 199.—ANOTHER FROM THE SAME.

a, layer of serotina; *b*, separation-plane through compact layer; *c*, villi. X. 25.

FIG. 200.—ANOTHER FROM THE SAME.

a, compact layer of serotina; *b*, decidual hillock; *c*, villi; *d*, spongy layer; *e*, separation-plane through upper part of spongy layer. X. 25.

FIG. 201.—SECTION THROUGH PLACENTA OF SIX-MONTH MISCARRIAGE.

a, layer of serotina; *b*, separation-plane through lower part of compact layer and through junction of compact and spongy layers; *c*, villi. X. 25.

FIG. 202.—ANOTHER FROM THE SAME.

a, layer of serotina; *b*, separation-plane; *c*, villi. X. 25.

FIG. 203.—ANOTHER FROM THE SAME.

a, layer of serotina; *b*, spongy layer; *c*, separation-plane; *d*, villi. X. 25.

FIG. 204.—ANOTHER SECTION THROUGH MEMBRANES NEAR PLACENTA IN A SIX-MONTH PREMATURE DELIVERY.

a, decidual layer on membranes; *b*, separation-plane of membranes through compact layer of decidua; *c*, chorion; *d*, degenerated villi of chorion læve; *e*, amnion. X. 25

PLATE XXVIII.

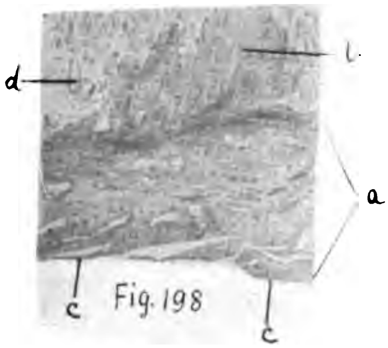

Fig. 198

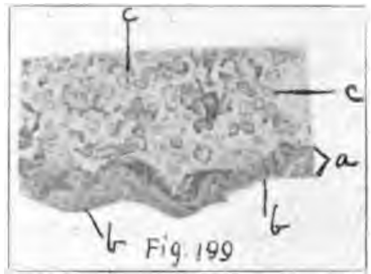

Fig. 199

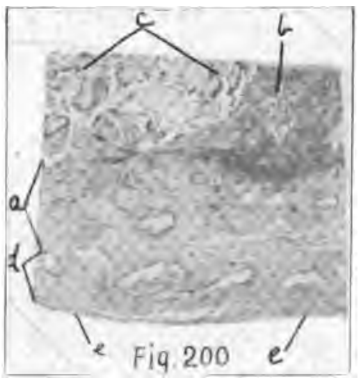

Fig. 200

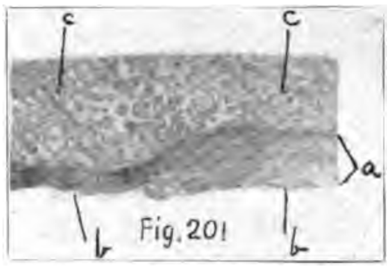

Fig. 201

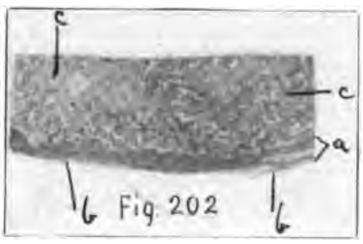

Fig. 202

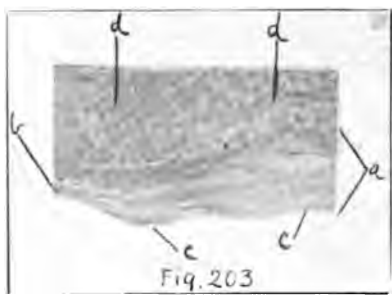

Fig. 203

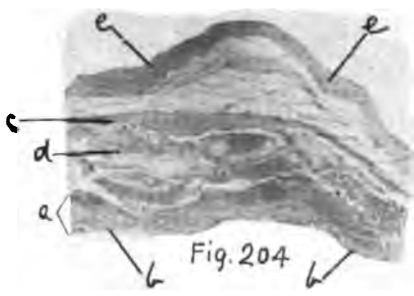

Fig. 204

PLATE XXIX.

FIG. 205.—SECTION OF SIX-MONTH PLACENTA.

a, layer of serotina on placenta; *b*, separation-plane; *c*, separation-plane, scarcely any decidual layer exists; *d*, villi. X. 25.

FIG. 206.—SECTION FROM FULL-TIME PLACENTA.

a, layer of serotina on placenta; *b*, separation-plane through compact layer; *c*, villi. X. 25.

FIG. 207.—ANOTHER FROM SAME.

a, separation-plane, no layer of serotina exists. The latter has probably been entirely absorbed at this part, or the villi had separated from the surface; *b*, villi. X. 25.

FIG. 208.—ANOTHER FROM SAME.

a, compact layer of serotina; *b*, spongy layer; *c*, separation-plane through spongy layer; *d*, villi. X. 25.

FIG. 209.—SECTION THROUGH FULL-TIME MEMBRANES.

a, amniotic epithelium; *b*, amniotic connective tissue; *c*, strands between amnion and chorion; *d*, chorion; *e*, serotina; *f*, separation-plane through compact layer; *g*, blood; *h*, villus near edge of placenta. X. 25.

FIG. 210.—ANOTHER FROM SAME.

a, layer of serotina; *b*, separation-plane; *c*, chorionic epithelium; *d*, chorionic connective tissue; *e*, amniotic connective tissue; *f*, amniotic epithelium. X. 25.

PLATE XXIX.

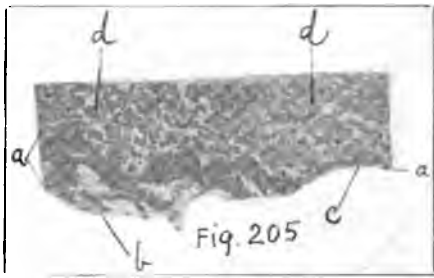

Fig. 205

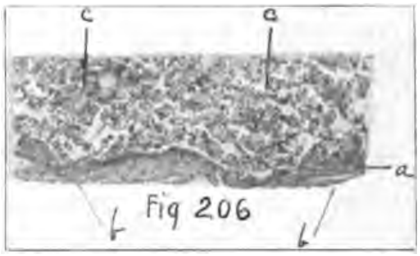

Fig 206

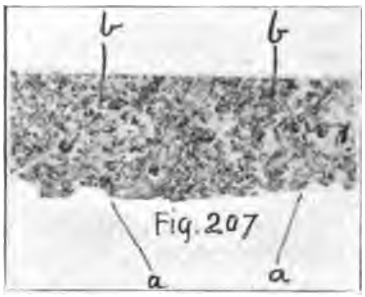

Fig. 207

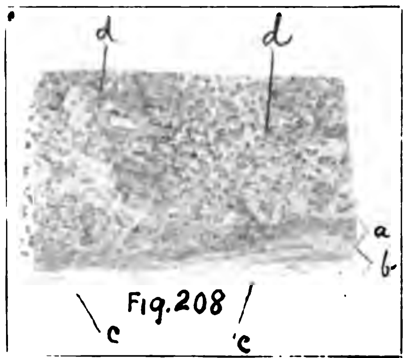

Fig. 208

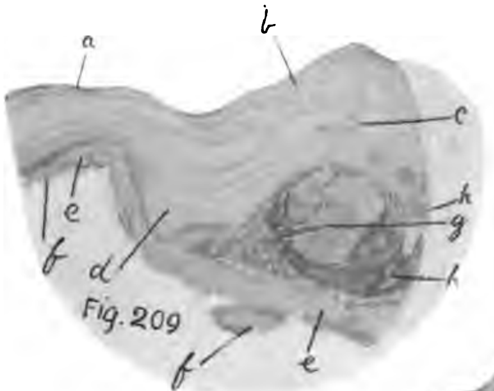

Fig. 209

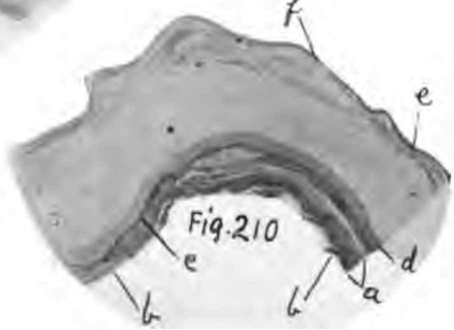

Fig. 210

PLATE XXX.

FIG. 211.—SECTION THROUGH INNER PART OF WALL OF FULL-TIME UTERUS IMMEDIATELY AFTER DELIVERY.

a, strands of spongy layer, separation-plane, non-placental area; *b*, muscle of uterine wall. X. 25.

FIG. 212.—ANOTHER SECTION FROM FIRST-DAY PUERPERAL UTERUS, PLACENTAL AREA.

a, remains of serotina; separation-plane has passed through compact layer; *b*, muscle of uterus; *c*, blood-clot lying on surface. X. 25.

FIG. 213.—ANOTHER FROM SAME.

a, remains of serotina; separation-plane is partly in compact and partly in spongy layer; *b*, muscle of uterus. X. 25.

FIG. 214.—ANOTHER OF SAME.

a, remains of serotina; separation-plane has evidently passed through outer part of spongy layer; *b*, muscle of uterus; *c*, blood-clot lying on surface; *d*, gland-spaces without epithelium. X. 25.

FIG. 215.—ANOTHER FROM SAME.

a, remains of considerable part of spongy layer of serotina; *b*, muscle. X. 25.

FIG. 216.—ANOTHER FROM SAME.

a, muscular part of uterus laid bare; no decidua seen; *b*, slight remains of spongy layer of decidua. X. 25.

PLATE XXX.

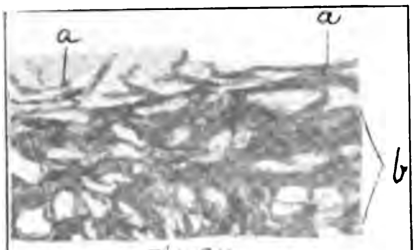

Fig. 211

Fig. 212

Fig. 213

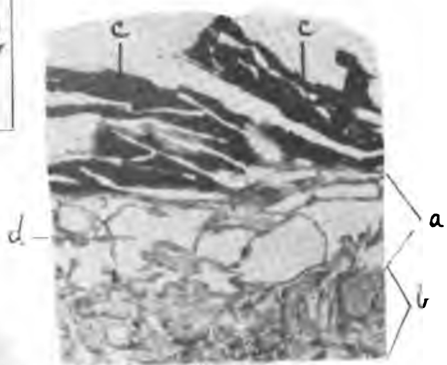

Fig. 214

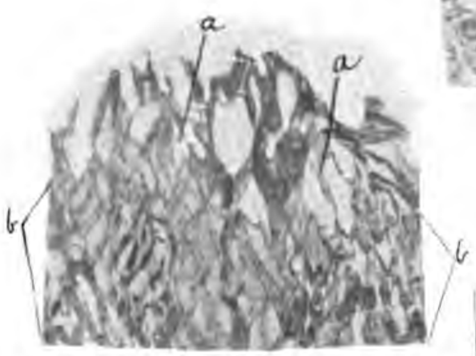

Fig. 215

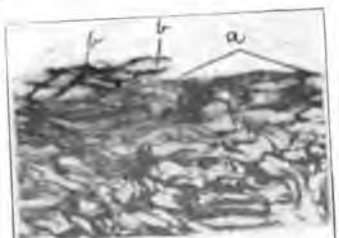

Fig. 216